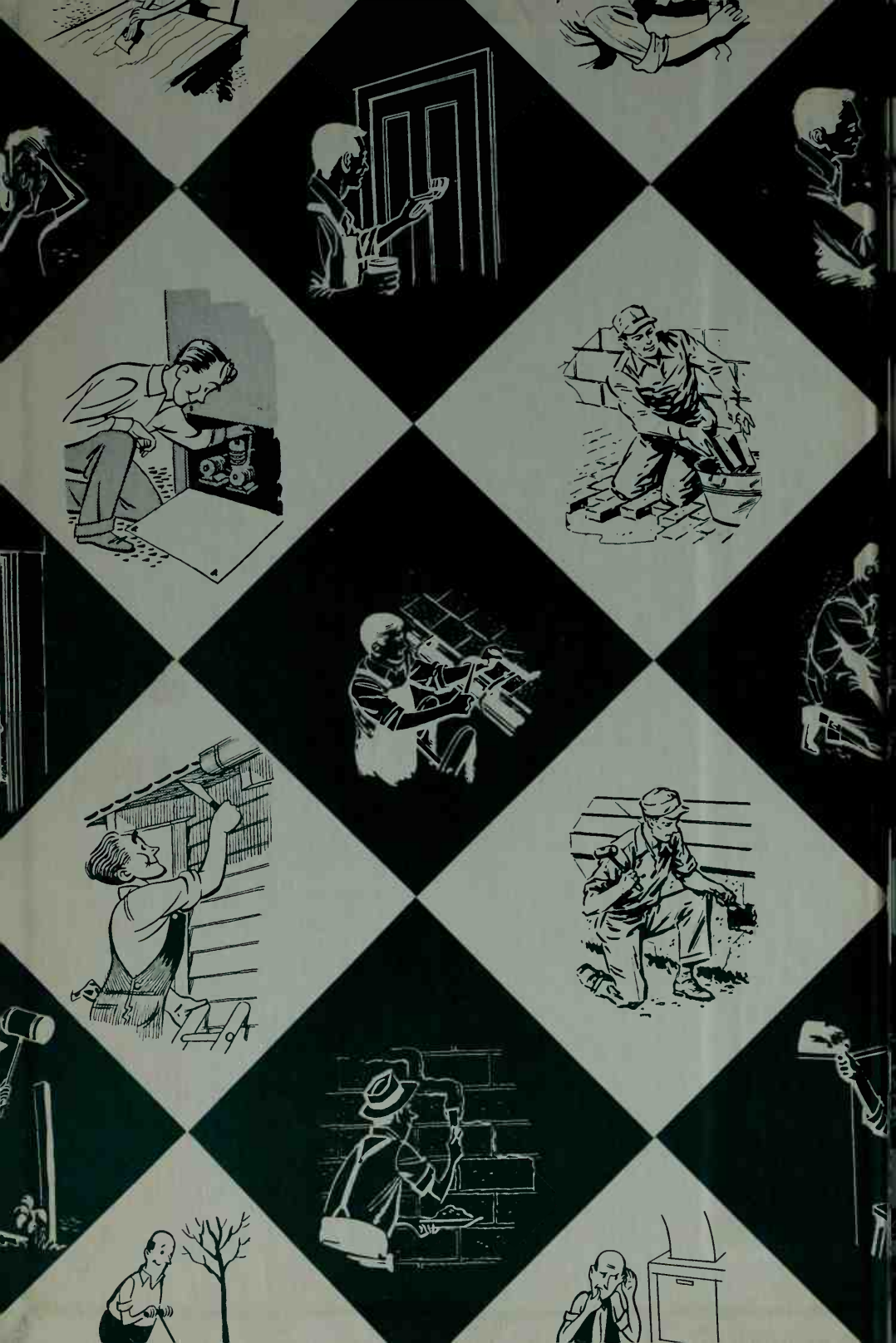
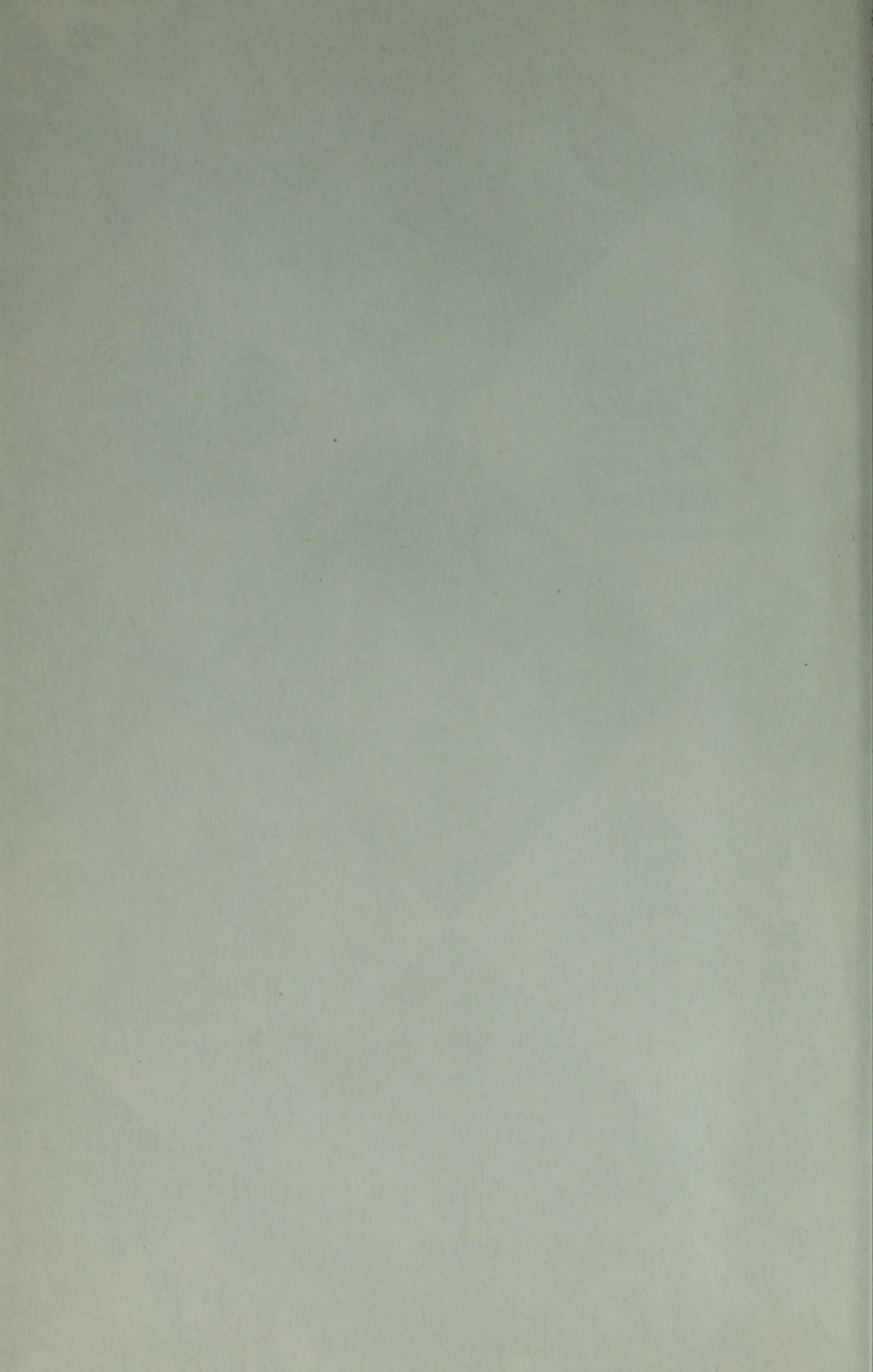


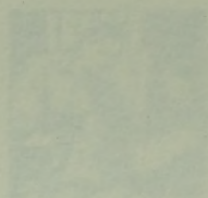






POPULAR MECHANICS DO-IT-YOURSELF ENCYCLOPEDIA

HOME OWNER, CRAFTSMAN
AND HOBBYIST
IN TWELVE VOLUMES



Volume XII

Complete Index to Volumes I-XII

J. J. CUFFIE & SONS CO., INC. • NEW YORK

POPULAR
MECHANICS
DO IT YOURSELF
ENCYCLOPEDIA

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FOR

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Volume XII

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J. J. LITTLE & IVES Co., Inc. • NEW YORK

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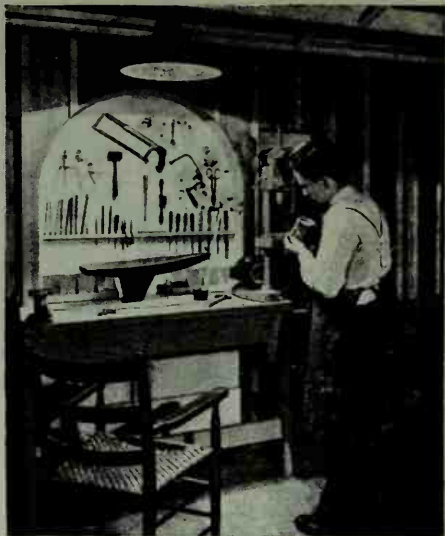
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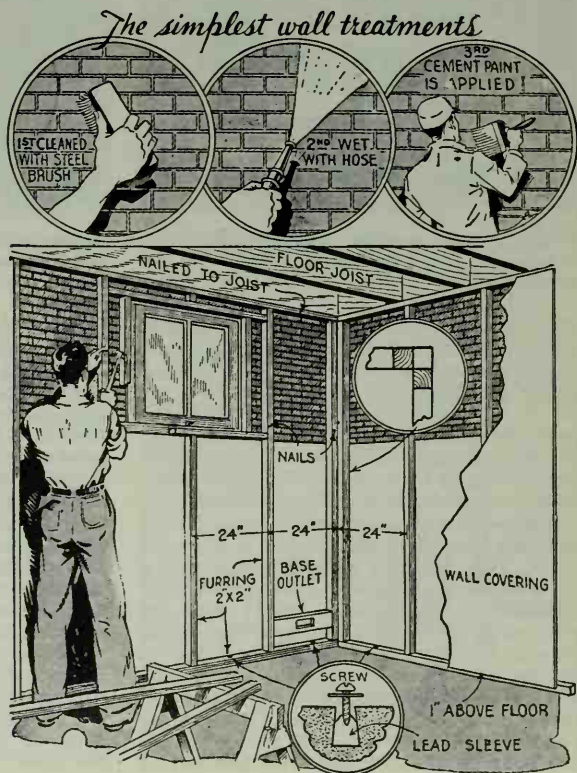


Workshops look well paneled horizontally with pressed board (left) or vertically with knotty pine (right)

WATER PROOFING

DECORATION of the basement shop is usually limited and most crafters will settle for a coat of paint. For this purpose you can use powder-type cement paint mixed with water, any of the popular water-mix paints, rubber-bonded cement paint or plain whitewash. Because of the porosity of concrete walls or blocks, application is best done by spraying, using a double-header coat, that is, up and down stroking for the first, horizontal for the second. Sure, you can also slap the stuff on with a brush. Floors can be painted with the powder cement paint, rubber-bonded cement paint, or the ordinary oil paint sold for porch and deck use.

Maybe you will go in for a little more dolling-up, and in this direction you have a choice of many different kinds of composition boards as well as plywood and plain lumber. The right-hand photo above shows a shop paneled in 1 x 12-in. knotty pine with battens (lattice strips) over the joints. The boards are

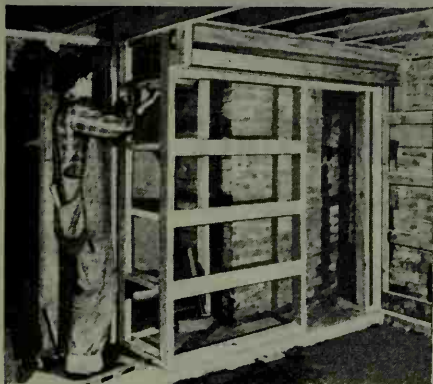




If a new ceiling is to be fitted, it should be put on before walls. Preparatory work includes leveling all joints and running in wiring and lighting fixtures



Furring is the main job in fitting a new wall. The wood is usually 1 x 3 or 1 x 4 strips. Worker here is fitting backing blocks to level the furring strips



A new wall gives wonderful opportunities for putting in built-in shelves, false framing, cabinets and tool panels. A concrete footing should extend under them



U. S. Gypsum photos

Molding hides the joints between ceiling and wall and wall and floor. The wall covering for the job shown in photos here is 16-in.-wide Weatherwood planking

stained previous to applying the battens, after which the whole surface gets a coat of flat lacquer or varnish. The left-hand photo on first pg. shows a treatment using 16-in.-wide Weatherwood plank. This is a pressed-wood pulpboard, ½ in. thick, pre-finished, available in various widths and in lengths up to 12 ft. Numerous other composition boards are equally satisfactory.

Any wall material must be applied over suitable furring strips fastened to the concrete. This provides a nailing strip and a level surface, and also prevents direct-to-concrete contact which might pick up dampness. There are no particular tricks in applying furring—you use any size of timber and space it to provide a base for the wall material you plan to use. The main difficulty is in fastening the furring to the concrete and the worst part of this is boring holes in the concrete. This job can be

speeded up considerably if you use a carbide-type masonry drill. Once the holes are drilled, they can be plugged with wood, rawhide, lead, or any of the various metal anchors made for this purpose. If the hole goes into the hollow of the block, toggle bolts are excellent for fastening. The application of the wall material itself is usually a simple job of nailing. It is best to keep the wall covering clear of the basement floor to guard against possible moisture absorption. The opening is neatly covered with a baseboard or molding. Possibilities of making built-in cabinets in connection with the paneling should be given consideration.

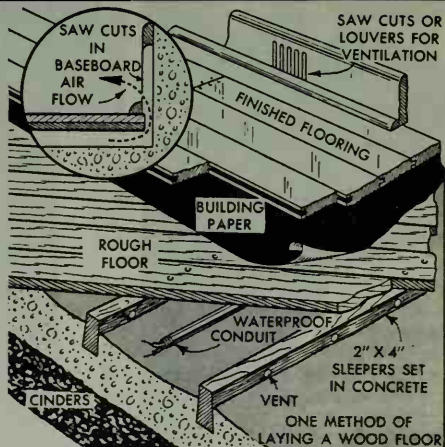
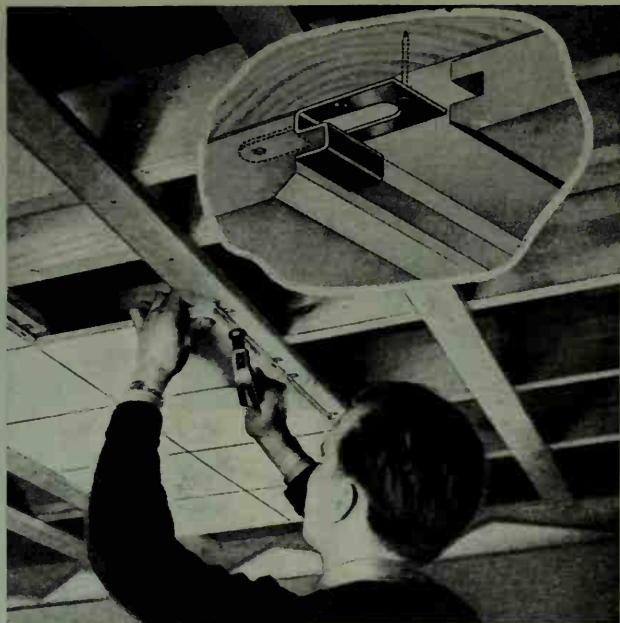
Similar treatment is given the ceiling. Furring strips may or may not be required, depending on the levelness of existing joists and the type of ceiling panel you are using. If you use a composition board in tile form, the furring would be spaced to

suit. Metal clips, as shown in photo at right, can be used for fastening, but ordinarily the board is simply toenailed with 1-in. No. 17 wire brads. Larger tiles or paneltile (larger sheets, scored) can be applied without furring.

Other than paint, the best floor treatments are asphalt tile or wood. Cemented linoleum should be avoided, although a loosely laid job is satisfactory in a dry basement. Concrete floors to be covered with asphalt tile should be patched and smoothed, since any humps or cracks will eventually show through. The tile is laid directly over the concrete, without felt backing, and the cement used should be the special type made for this purpose.

A wood floor gives the basement shop a comfortable feeling. A suitable type of construction is shown in the drawing at right. This is shown for new construction, but it can also be worked over an old floor—there is no actual need to bed the sleepers in concrete. The flooring is left a little clear of the wall all around so that air can circulate through several openings cut in the baseboard, as shown. The drawing shows a double floor, but a single thickness is satisfactory. The wood should be stored on the basement floor for three or four weeks before application so that it will have the proper moisture content. A worthwhile protection against slight dampness would be a coat of asphalt or hot tar applied to the concrete and underframing. Wood floors are 100-percent practical only when the basement is completely dry. However, a wood floor is sometimes put down simply to get above a wet basement floor. When the area is not too large, this is quite practical and, if the underframing and underside of floor are coated with asphalt pitch, the job will last for many years. Ventilation in this case would be important, and suitable limber notches and openings should be provided for passage of both floor water and air. Many crafters use a modification of this idea in the form of sheets of composition board or rubber matting.

Photo at top of page shows inset of metal clip used for fastening composition tiles to furring. Drawings below illustrate methods of laying a wood floor in a basement and applying tiles to special cement base





SPRUES

THE SPRUES ARE "WELDED" TO THE
WAX PATTERN WITH A HOT NEEDLE

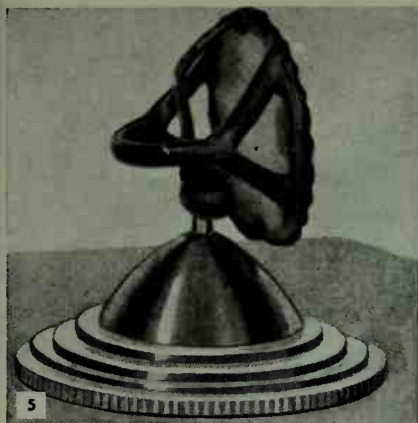


PLACING WAX PATTERN IN POSITION
ON THE WAX BALL OF FLASK BASE

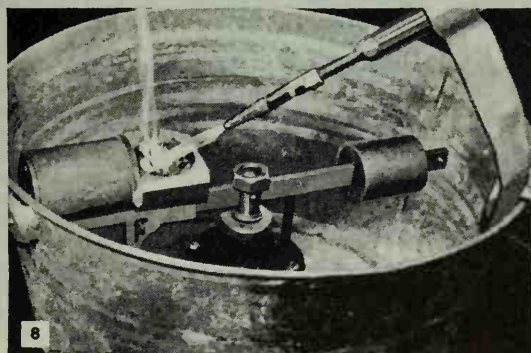
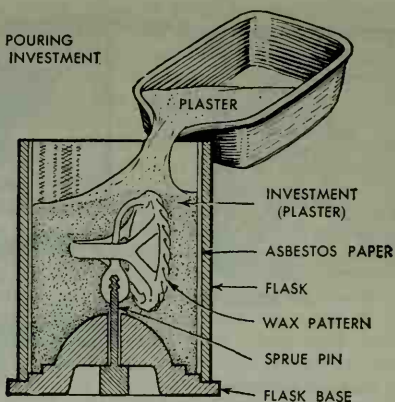
WAX CASTING

LOST-WAX casting makes it possible for the home craftsman to reproduce in metal any form he can model in wax. Unlike sand casting, which demands experience and unwieldy equipment, the technique of this method can be learned in a single day with a minimum of special equipment. It is particularly adaptable to making small metal parts for model work and jewelry, such as the ring shown in Fig. 1. Regardless of how delicate or intricate the design may be or how high the relief or depth of undercutting on the pattern, the final casting will be an exact duplicate. In professional work, ferrous alloys are often used, but these are difficult for the home craftsmen to melt because of the high temperatures required. However, bronze, brass, gold, silver, aluminum, zinc and the white-metal alloys are easily cast.

Briefly, the lost-wax process consists of making a pattern from wax, as in Fig. 3, placing it in a flask and filling the flask with plaster to form a mold, or investment around the pattern, Fig. 9. After the plaster hardens, it is heated until the wax pattern melts and flows from the



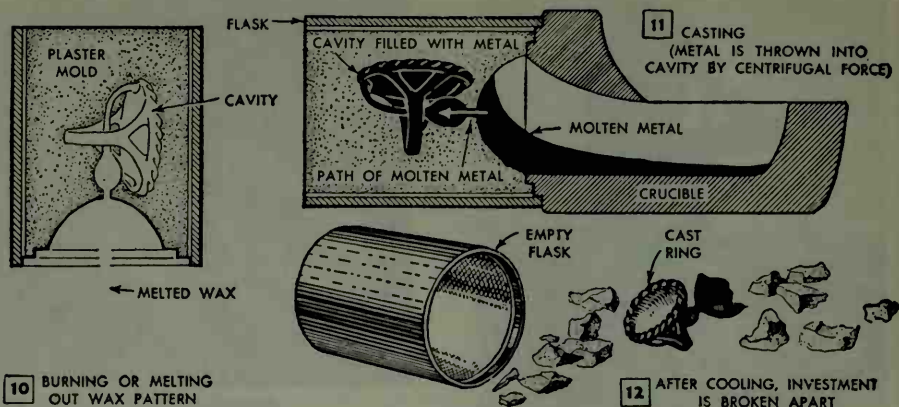
9 POURING
THE INVESTMENT



mold, leaving a cavity shaped exactly like the pattern, Fig. 10. The mold, together with a crucible full of molten metal, is then placed in a centrifugal casting machine which forces the metal into the cavity, Fig. 11. After the metal has solidified, the casting is obtained by removing the mold from the flask and breaking it apart as in Fig. 12.

The wax, as well as the special mold plaster, can be compounded by the user. However, the centrifugal casting machine should be purchased, as the details of its design make it expensive and impractical to build. The cost of a commercial casting machine is comparable to the price of a small drill press or circular saw.

The simplest soft wax for patterns is made by mixing equal parts of beeswax and paraffin. Since paraffin is available in several different melting temperatures, it is possible to vary the hardness of the wax mixture. If the wax pattern is to be formed by cutting or carving, a still harder mixture can be made by adding ceresin and carnauba wax to the beeswax and paraffin. One mixture suitable for carving consists of equal parts of the four ingredients. Another is made from four parts each of beeswax and paraffin, two of ceresin and one of carnauba. The best method is to vary the quantities of each ingredient until you obtain a wax with the degree of hardness best suited to your needs. Regardless of the mixture, the wax must melt



and burn away completely when it is heated so that no ash or residue remains in the plaster mold.

The plaster must withstand high temperatures without breaking down, and yet must crumble easily when wet. This is usually made by mixing plaster with soapstone, asbestos lint or calcined diatomaceous earth. The best mixture for fine detail is the commercial material having a cristobalite base. A mixture containing plaster of paris, five parts, powdered coal ash, three parts, and powdered talc, one part, may be used successfully. A mixture of eight parts plaster, six parts asbestos powder and one part powdered talc also is good. The aggregates are mixed with water to the desired consistency.

A miniature gas or electric furnace or a torch can be used to burn out the wax pattern and melt the casting metal. For castings that can be enclosed within a $\frac{3}{8}$ -in. cube, a mouth blowpipe and Bunsen burner will do. For larger castings, an ordinary gasoline blowtorch, an oxyacetylene welding torch or any gas-burning torch having a forced-air supply may be used.

To make a piece of jewelry, for instance, the design is first drawn on paper to exact size. Then, using this as a guide, thin sheets of the transparent wax are laid over the design and the various shapes cut out with a sharp needle set in a wooden handle. The wax pieces are formed and then assembled by holding their edges together and touching the junction with a hot needle to weld the pieces together. When the assembly is completed, the rough places are scraped smooth with a small scraper, made from a piece of metal $\frac{3}{32}$ in. wide fitted with a handle. Small pieces of wax may be added and carved as desired. Every extra minute spent in shaping the wax pattern will save 10 or 15 minutes in dressing down the final

metal casting. Every defect in the wax pattern will be reproduced. In fact, with a little experience in patternmaking, you can reproduce minute detail visible only on the most careful inspection.

No vents are used in this type of casting. However, it is necessary to provide channels, known as sprues, to allow molten metal to reach all parts of the mold before it starts to solidify. These are made of pieces of wax, rolled into rods of about $\frac{1}{16}$ in. dia., and are fastened to the pattern by the hot-needle method as shown in Fig. 3. After the sprues are attached, the pattern is ready to mount in the flask of the casting machine. The flask is simply a length of brass pipe and a tightly fitting base which is shaped to form a funnel-like depression at one end of the plaster mold. A hole through the center of the base is fitted with a large-headed pin, the tip of which is wrapped with a length of sprue wax carefully shaped and melted into a ball, Fig. 4. The sprues of the pattern are then fastened to the wax ball with a hot needle. This holds the pattern firmly to the base in the desired casting position.

The success of the casting depends upon the care used in making the plaster mold, or investment, Fig. 9. A small amount of the investment is mixed to a creamy consistency and brushed on the pattern as in Fig. 6. The brush is used to work the investment into every detail of the pattern and also to remove small air bubbles. After covering, the investment is allowed to set until half hard but not dry. Meanwhile, the flask is lined with thin asbestos paper, wetted so it will adhere to the inner walls. The flask is then placed over the invested pattern, Fig. 7, and fitted to the base. Another batch of investment, mixed thick enough just to flow smoothly in a sluggish stream, is poured into the flask until a slight



Above, appearance of casting with sprue and sprue base after removing from flask. Tiny white spots are bits of investment. Below, sprues are cut off leaving stumps which are ground flush with casting



the mold. This is done by the application of heat, about 500 deg. F., for a half hour. The wax melts and runs out as in Fig. 10. But, as it usually ignites and burns when it reaches the air, no wax is recovered. Hence, it becomes the "lost wax." This may be done in a furnace or by supporting the flask over a medium flame of a gas burner. After the bulk of the wax is removed, the residue must be removed by a thorough burning out. In the furnace, this is done by increasing the heat to 1200 deg. F. for one hour. If a gas burner is used, a tin can turned upside down over the flask will act as an oven chamber. At the end of the burning-out period, the flask and mold, shown held with tongs by the gloved hand in Fig. 2, is securely clamped between the crucible and thrust plate located at one end of the rotating arm of the casting machine. The other end of the arm has an adjustable weight to counterbalance the flask, crucible and metal to be cast. It is essential that this balancing be done before the cast is made. The arm is fastened to a shaft projecting above the center of a metal base inclosing a strong spiral spring which rotates the arm. In use, the arm is turned against the spring about three turns and a gravity stop pin raised to hold it in place. The flame from a gas torch is then directed on the metal in the crucible, Fig. 8, until the metal is melted. When the metal is completely melted, a pinch of borax is dropped on it, and as soon as the metal surface shows bright and clean it is ready for casting. The counterweighted end of the arm is then pulled back about $\frac{1}{4}$ in. against the spring, thus allowing the gravity pin to fall clear, to release the arm. Centrifugal force causes the molten metal to flow into the mold cavity as in Fig. 11. After four or five minutes, the flask is removed from the machine and cooled slowly by quickly dipping it 10 or 12 times in a pan of water until it is cool enough to handle. Usually, the mold and its asbestos wrapping will slide out of the flask when cooled with water. If not, the investment, which has the consistency of thick sludge, will come out easily if dug into with a screwdriver. The casting will come out covered with a film of investment, which can be removed by scrubbing with a stiff brush. The casting, Fig. 13, now duplicates the original wax pattern and part of the base, Fig. 5. The base is removed by cutting or sawing the sprues as close to the casting as possible, and the remaining stumps of the sprues are ground off flush with the surface of the casting with a small abrasive wheel as indicated in Fig. 14. In most cases, any surface discoloration on the casting will disappear when buffed with a cloth or felt wheel loaded with polishing compound.

crown is formed above the top. After the investment is semisolid, the crown is scraped level with the top of the flask. The investment is then allowed to set until hard, after which the sprue pin is removed and the base separated from the flask. The mold, which is still surrounded by the flask, can be dried in two hours by placing it in an oven heated to about 100 deg. F., but it is advisable to let it stand overnight.

The next step is removing the wax from

WEATHER STRIPPING

When sharp wintry winds reach full velocity and temperatures drop below freezing, the unsealed doors and windows of your home may account for as much as 40 percent of the total heat loss during an average day. Weather stripping alone can reduce this loss as much as 20 percent, even without the addition of storm sash and storm doors. There are many kinds of weather stripping, some designed only for temporary use, such as plain felt strips, felt strips with a wood or metal backing, and rubber-coated fabrics. The interlocking types made from bronze, brass or other rustproof metals are designed for permanent installations. The interlocking types are, of course, the best in the long run as they do not require a friction contact to form an effective seal. Doors and windows fitted with these types open and close as easily as before stripping, while the friction-seal stripping makes window sash somewhat harder to raise and lower and doors a bit more difficult to close. Both types, however, make a very effective seal against heat loss.

The initial cost of weatherproofing will be repaid in savings on fuel bills over a period of years. If you can afford only a few sash, put them on the sides exposed to the prevailing cold winds. The space between the regular sash and the storm sash should be as much of a dead-air space as possible. Therefore, the regular sash should be fitted with weather stripping, strips of wood and felt set snugly against the sash if regular metal weather stripping is not available. Also, the storm sash should be fitted into the frames tightly, which can be done by gluing strips of felt to the sash where they contact the frames. In some cases it may be advisable to seal cracks between sash and frames by adhesive tape. Ventilator holes in the storm sash are handy to admit a slight amount of fresh air, but when not used for this purpose, they must be sealed. These ventilator holes should be closed tightly by corks or snug-fitting covers, as leakage at these points defeats the purpose of sealing the sash.

Except along the bottom edge, a door can be weather-stripped with the interlocking type, cut and bent to the shape shown in detail A of the series of detail illustrations A to K inclusive. If this material is not available from local hardware, lumber, or building-materials dealers, a sheet-metal shop can prepare it at small cost. Zinc is quite commonly used as it is easy to work, but any other corrosion-resistant metal, soft enough to be formed to the desired shape, may be used. A splice is made by snipping a tongue out of the sheet metal

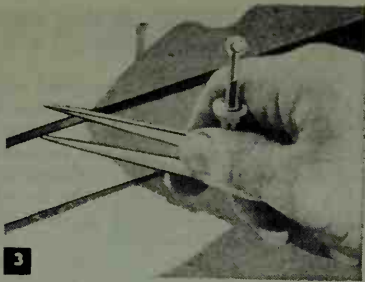


One way to test a weather-stripped door for air leaks is by moving a lighted match along opening between door and jamb. Flame flickers if air is entering the room. Tests have shown that as much as 20 percent of fuel can be saved in many cases by having weather stripping on all windows and doors. Ordinary felt weather stripping can be fastened by gluing the stripping to the doorjamb where it contacts closed door



2

Before weather-stripping a door, true it up to assure uniform clearance between door and jamb. Be sure to plane edges square

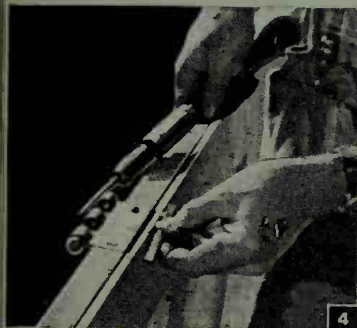


3

as in detail B and inserting it in the folded flange of the other piece. Rustproof nails should be used.

The first step before removing the door is to see that it is hung properly. It may be necessary to

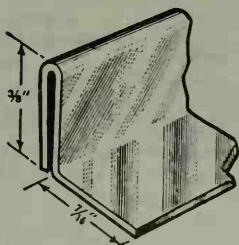
plane off some high spots, as in Fig. 2, or to shim up one of the hinges. If the wooden threshold is worn down in places, plane it level. Then, with dividers, scribe a line along the bottom of the door as in Fig. 3, using the threshold as a guide for the lower point of the dividers. These should be set so that the bottom of the door, when sawed along the scribed line, will clear by $\frac{1}{16}$ in. the top of the brass threshold to be installed, Fig. 10. After marking the bottom of the door, remove the door from the frame, block it on the floor with the hinged edge up, and remove the hinge butts. Using a rabbet plane or an electric hand plane such as shown in Fig. 7, cut a $\frac{1}{8}$ by $\frac{3}{8}$ in. rabbet the entire length of the door. With a hacksaw, cut a piece from the outside edge of each hinge



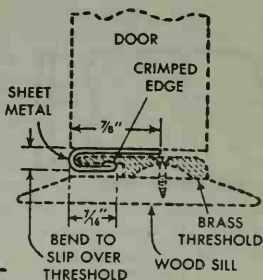
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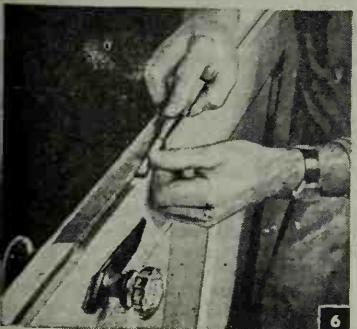
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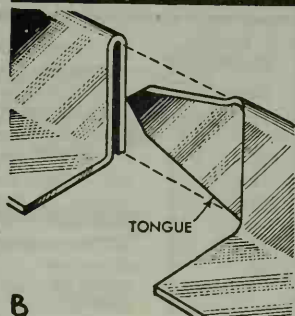
A
SHEET-METAL WEATHER STRIP .020" TO .024" THICK



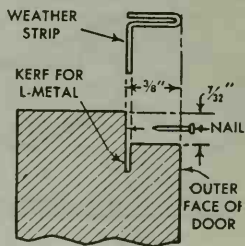
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B

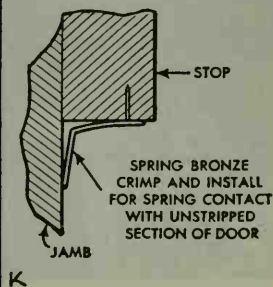
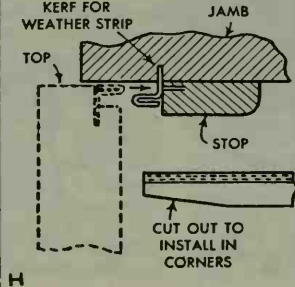
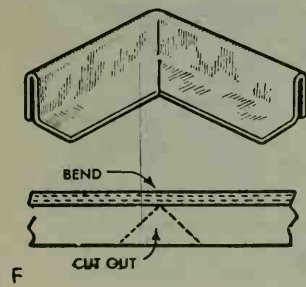
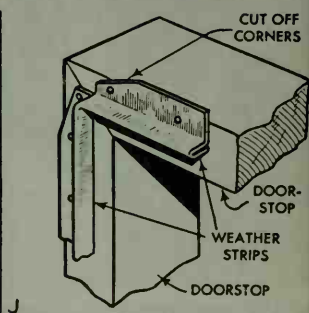
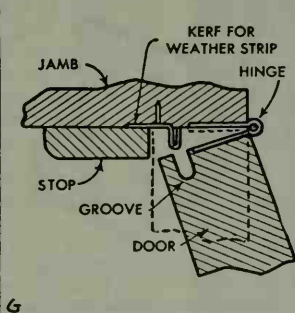
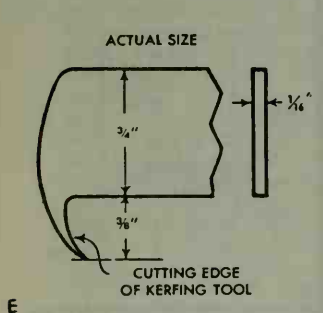
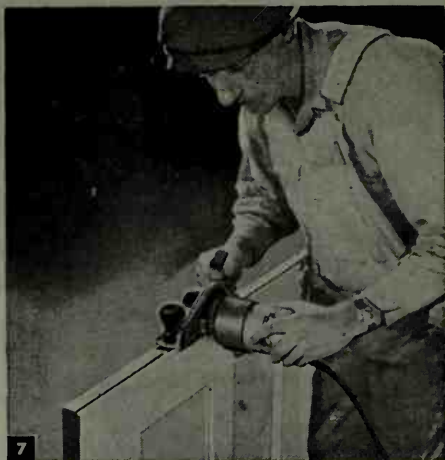


D

butt just wide enough so that, when the butt is replaced on the door, it will clear the rabbet, Fig. 4.

Now, following the line scribed near the bottom of the door, saw off just enough to clear the brass threshold. If a felt door bottom is to be used, this can be nailed or screwed to the door after rehung; but if the metal threshold is of the interlocking type with overhanging lip, then be sure that allowance is made for the interlocking bottom strip which is nailed to the bottom of the door, as in detail C, to interlock with the threshold lip. This can be bent to the dimensions given from the same material as the weather strip used on the rest of the door, unless, of course, a similar strip is purchased ready-made. Attach the strip, as shown, with the back of the hook flush with the inside face of the door.

As the lock side and the top of the door are weather-stripped in the same manner, rabbet the outside edge of each as in detail D. Dimensions should be maintained closely so that the edge of the weather strip will not extend beyond the outside face of the door, Fig. 8, as the strip which later is installed on the jamb must be fitted to interlock closely without binding. A suitable kerfing tool to cut the groove for the metal edge can be made from a piece of steel, with a cutting point filed or ground as in detail E. A short length of saw blade not less than $\frac{1}{2}$ in. wide and bolted to a handle, also will serve this purpose. If there is sufficient clearance between the striker plate and the edge of the door, the weather





strip can be installed for the entire length of this side. Otherwise, cut the rabbet up to the striker plate and then taper the cut with a chisel as in Fig. 6.

The metal strip now can be nailed in place as in Fig. 5, with the outside edge flush with the edge of the door. Fit the strip at the corner by snipping out a vee and bending around the corner as shown in detail F. When necessary to join at other points along the length, pieces are fitted together with a tongue as in detail B.

With work on the door completed, the weather stripping is now installed on the jamb. Detail G shows one method used when installing the strip on a new door frame, the strip being nailed in a groove cut in the jamb. If the door frame is already installed, cut a shallow rabbet in the back of the stop to a depth equal to the thickness of the strip. In this way, it is unnecessary to groove the jamb. In either case, best procedure usually is to install the threshold and fit the metal top strip first, as the two sides are more easily fitted to these later. Install the threshold and the weather strip for the top as in detail H, fitting both to the mating strips on the door. Then the vertical strips are installed, making sure that the groove in the hinged edge of the door closes over the metal without binding. As the kerf cannot be cut to sufficient depth at the corners, snip the metal so that a neat bend can be made, as in detail J, before installing. The metal strip on the lock side of the door is installed in the same manner as the top strip.

If the door is warped slightly, this may be corrected in most cases by planing the



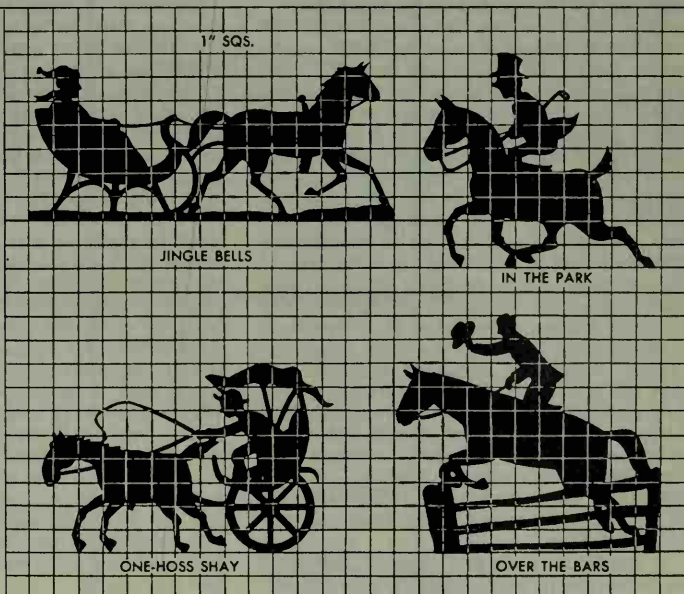
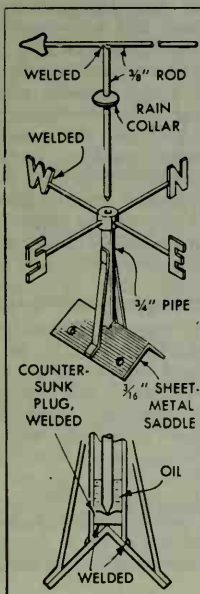
Above, on old door frames a metal threshold is carefully installed so that door will close without binding. Left, when installing metal stripping, space back of striker plate is closed with spring bronze

stop to make uniform contact with the outer edge of the door before installing the metal strip. Where the stop on the lock side of the door is planed to fit the warped door, it will be necessary to relocate the striker plate so that the door can be closed securely without rattling. Finally, crimp a strip of spring bronze and nail to the stop, as in detail K and Fig. 9, to close the gap at the striker plate. One way of testing a weather-stripped door for leaks is to move a lighted match slowly along the opening between the door and the jamb as in Fig. 1. If air is leaking in at any point the flame will flicker. Generally, the leak can be stopped by springing the strip slightly.

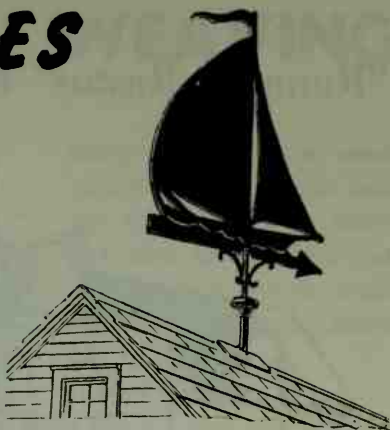
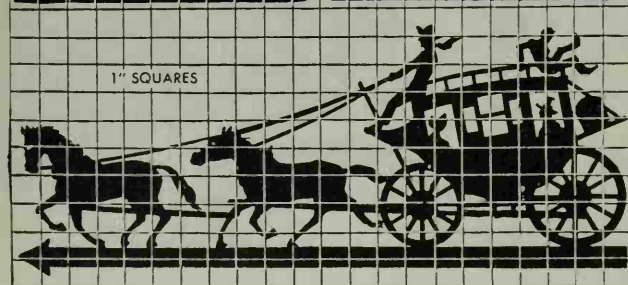
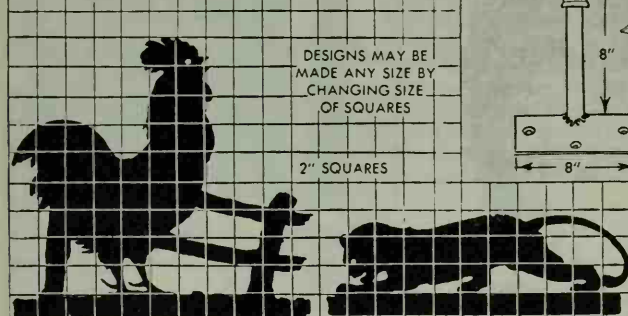
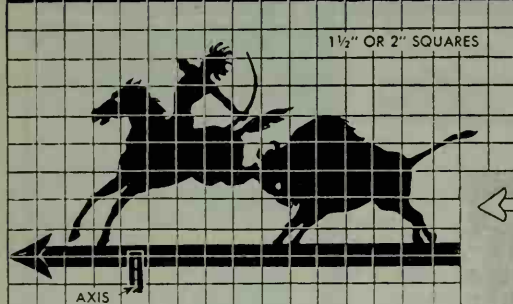
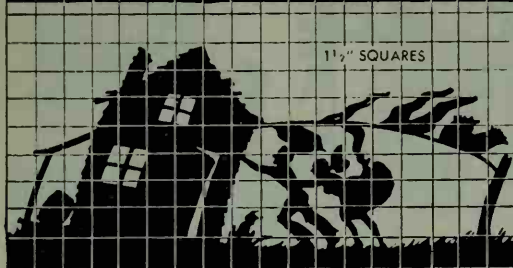
Methods of applying the interlocking weather strip to windows are essentially the same as those used in fitting it to doors. When the stripping is purchased ready-made, specially formed strips usually are furnished for the meeting rails of ordinary double-hung windows, and also for casement sash. Spring-bronze weather strip of the contact type is usually furnished in rolls from which the required lengths are cut with tin snips. It is one of the easiest of all to apply as it is supplied in uniform widths with adjustable contact edges and a perforated nailing flange. This type of stripping is fitted to both doors and windows in much the same way. To simplify installation, the contact strip often is applied only to the sides and top of the door frame and a metal-reinforced felt door bottom is screwed to the inside bottom edge of the door. Felt weather stripping, with or without metal reinforcing, is a more or less temporary installation. While the initial expense of providing complete insulation for the house may be considerable, it will eventually pay for itself in a short course of time by the steady savings in fuel that will result.

WEATHER VANES

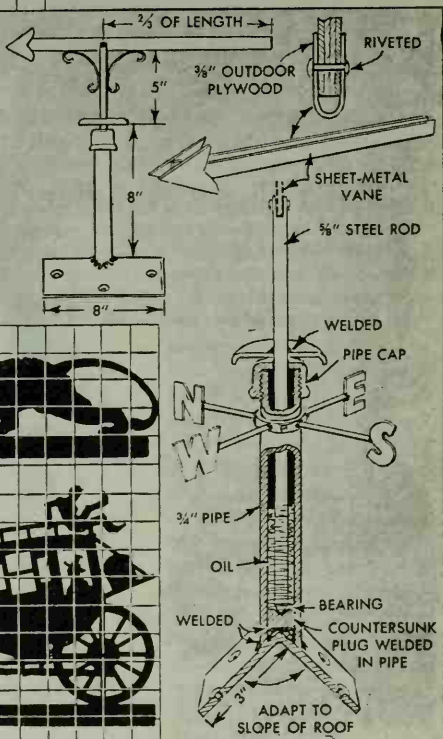
WIND DIRECTION may not be important to most homeowners but a weather vane pointing to windward atop the garage cupola adds that final touch in decorating the exterior of your home. The metal vane can be almost any design that suits your fancy, but profiles, or silhouettes, of horses either at rest or in action have always been the favorites. Shown at the right and detailed below are suggested cutouts for sheet-metal vanes which can be made of steel or aluminum, the latter being somewhat easier to work and less subject to corrosion. After you've selected the design you want, sketch it full size from the details and transfer the pattern to the sheet metal. Cut on the pattern lines with the jigsaw, using a fine-toothed, metal-cutting blade. Rough edges and sharp corners are then smoothed with a fine file and the completed cutout is riveted or welded to the directional arrow, which is made up from a length of $\frac{3}{8}$ -in. rod slotted at one end to take a sheet-metal arrow point, or head. The assembly is then welded to a $\frac{3}{8}$ -in. rod which pivots in a pipe sleeve. The lower end of the pivot rod is ground to a blunt, rounded point which seats on a metal plug welded to the inside of the pipe sleeve at the lower end as in the sectional view. The direction letters are cut from sheet metal and welded to short rods which are then welded to a coupling turned onto the upper end of the sleeve. The open top of the sleeve is closed by a brass rain collar soldered to the pivot rod while the lower end of the sleeve is welded to an angle-iron base which has been drilled for fastening to the ridge of the roof with wood screws. Finish both the vane and mounting assemblies with two coats of flat-black lacquer.



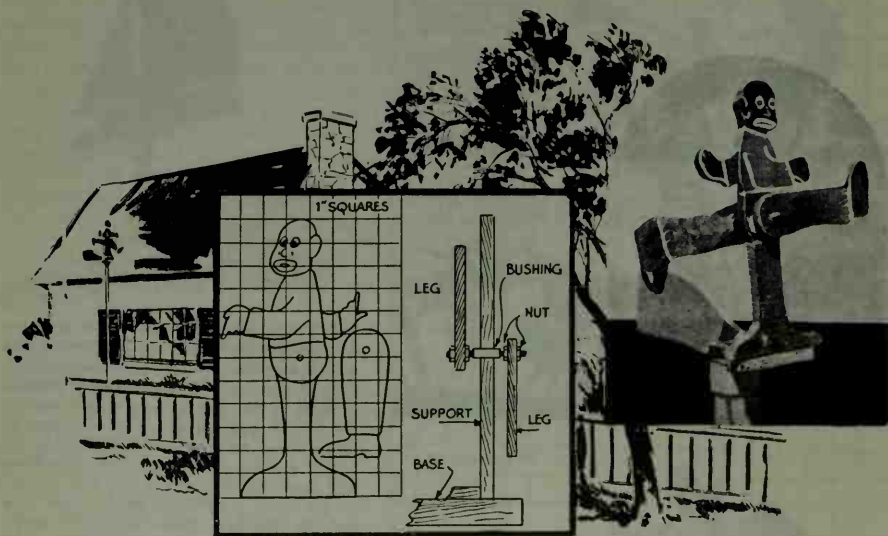
WEATHER VANES



In fair weather or foul, any of these vanes will tell you faithfully which direction the wind is blowing. The silhouettes are cut from outdoor plywood or sheet metal and finished in black so they can be seen clearly against the sky. If sheet metal is used, it should be fairly heavy to stand the buffeting of the wind. A suggested method of assembling and mounting the parts of the unit is given in the lower right-hand detail. Also note that the standard, which carries the arrow and silhouette, rides in a sealed bath of oil



"Running Rastus" Never Tires in the Wind

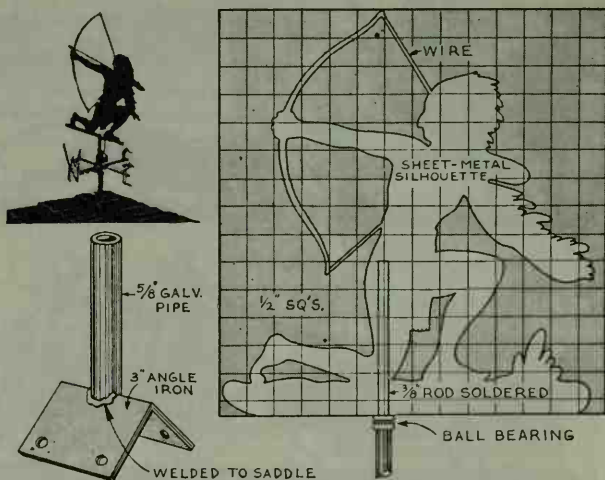


With his legs moving rapidly, "Running Rastus" is an amusing weather vane. Both the body and legs are scroll-sawed from $\frac{3}{4}$ -in. wood, after which the trailing edges of the legs are beveled like the blades of a

toy windmill, which they simulate. In assembling, the legs are locked on the threaded ends of a tiny shaft with nuts, a piece of tubing being inserted through a hole in the body to serve as a bearing.

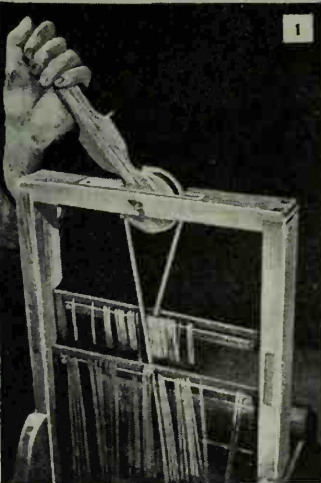
Indian-Hunter Weather Vane Adds a Frontier Touch

Crouching in a realistic manner atop a building, this silhouette of an Indian hunter with his strong bow, makes an ideal weather vane. The figure is cut from sheet metal and is soldered to a short rod, which fits inside a pipe welded to a short section of angle iron. A ball thrust bearing placed between the figure and the end of the pipe allows the weather vane to move in the slightest breeze. Letters on the standard indicating the directions further enhance the appearance.



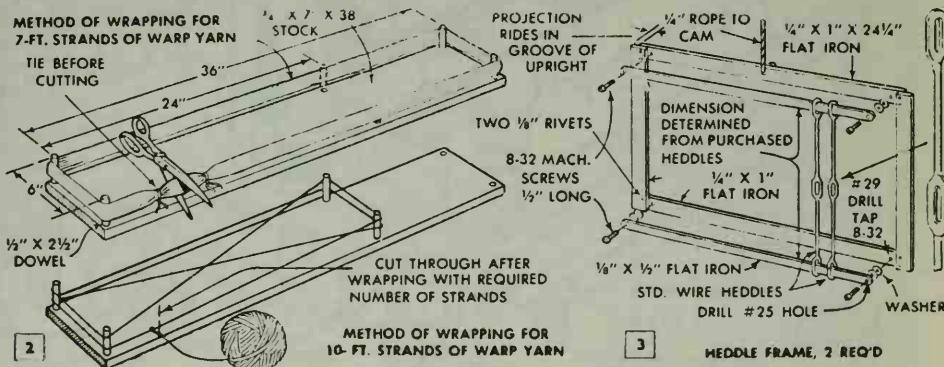
WEAVING

Many people have made weaving a profitable hobby with table-top looms like this one, which has several features to make the work easier and faster



WEAVING scarves, table runners, scatter rugs in varied colors and similar articles is not only an interesting pastime for long winter evenings, but it also can be developed into a profitable hobby. Once you have mastered the technique with a little practice, you will be able to produce woven articles that will find ready sale at a good price.

With the loom pictured above, you can produce many salable articles. It consists of a frame which supports such moving parts as the warp and whip beams, heddles and frames, a reed or beater and a shuttle, the latter being a separate part which is manipulated by hand. The shuttle carries the weft thread through the shed, a triangular space between the warp threads which is made by shifting the heddles after each stroke, or pass, of the shuttle. The beater or reed, hand-operated on small looms, is pivoted to the frame of the loom and is for the purpose of beating the weft thread into the warp after the shuttle has passed through the shed. The table loom detailed in Fig. 4,

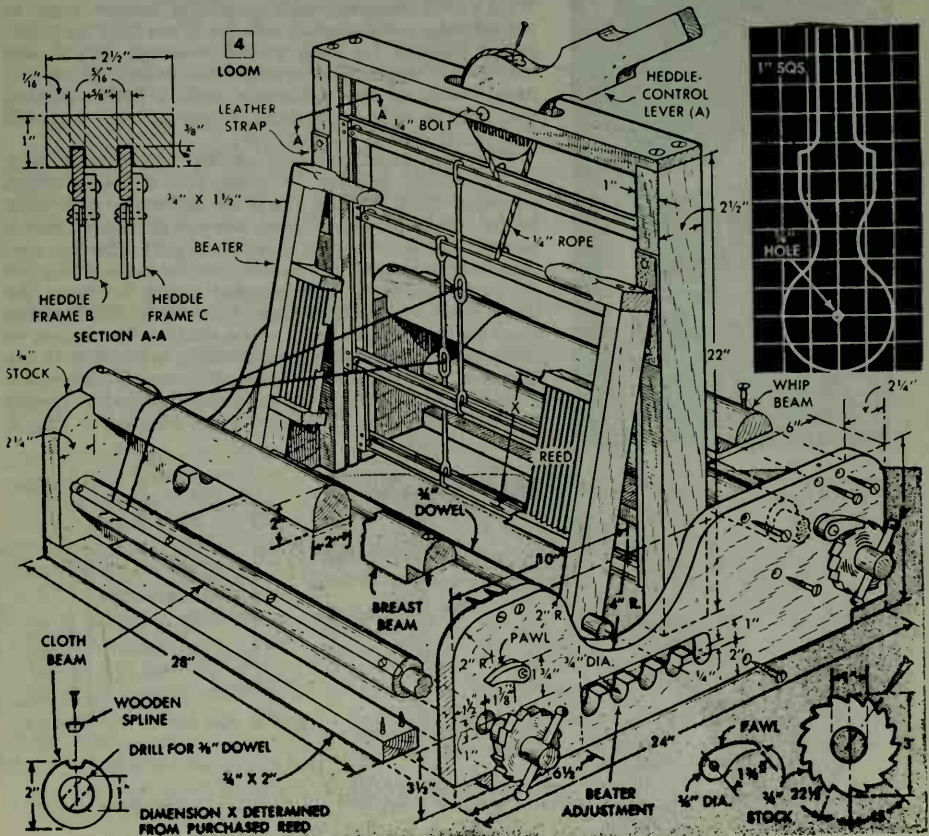


TEXTILE TERMINOLOGY

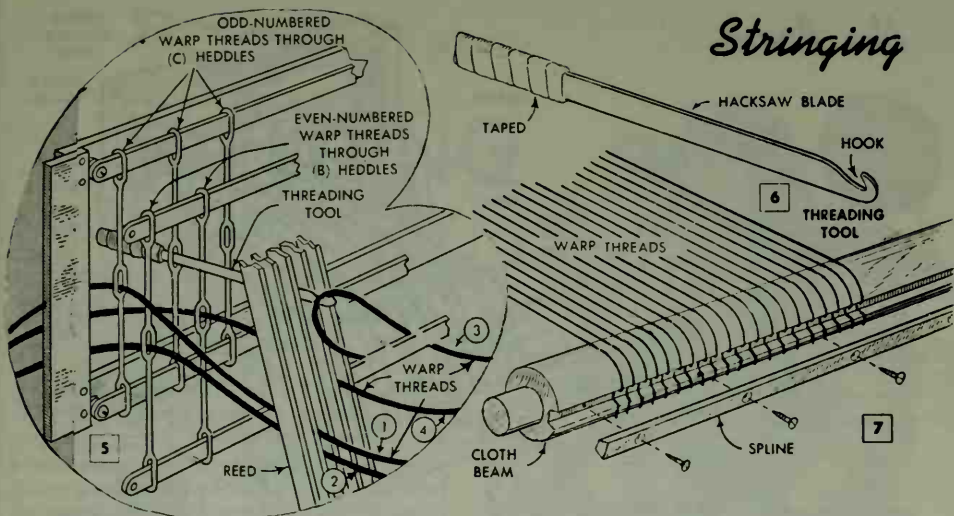
- **WARP BEAM:** The roller of a loom upon which the warp is wound.
- **HEDDLES:** Vertically held parallel wires having an eye in the center through which the warp is drawn.
- **WARP:** Threads that pass through heddles and reed.
- **SHED:** Space between warp when heddles are raised or lowered.
- **WEFT (WOOF):** Threads or yarn interlacing the warp at right angles.
- **SHUTTLE:** An instrument upon which weft is wound for passing through warp shed while weaving.
- **REED (BEATER):** A device to comb or beat the weft between the strands of the warp.

Before starting assembly, determine the size of the loom from the maximum width of cloth you desire to weave, keeping in mind, of course, the size limitations of the table-top type. As an example, the loom detailed in Fig. 4 is designed for a cloth width of 24 in. A smaller size also can be made with an over-all width of 16 in. for a cloth width of 12 in. This size is especially suited to weaving table runners, scarves, etc. Hardwood

REED (BEATER): A device to comb or beat the weft between the strands of the warp.



Stringing

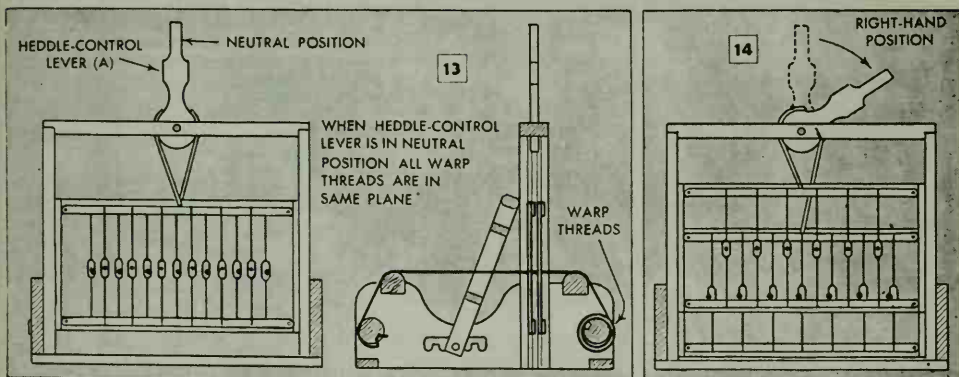


is used for all parts of the loom frame, the beater frame, rollers, and the breast and whip beams. Maple is good but birch does equally well and saws and planes somewhat easier. The heddles and heddle frames, Fig. 3, and the reed may be purchased from dealers in craftwork supplies. These parts are inexpensive and obtaining them ready-made saves a lot of time. For average weaving a 30-dent reed—30 spaces per inch—is satisfactory, as running the warp thread through each dent will give 30 warp threads per inch. Other combinations are possible.

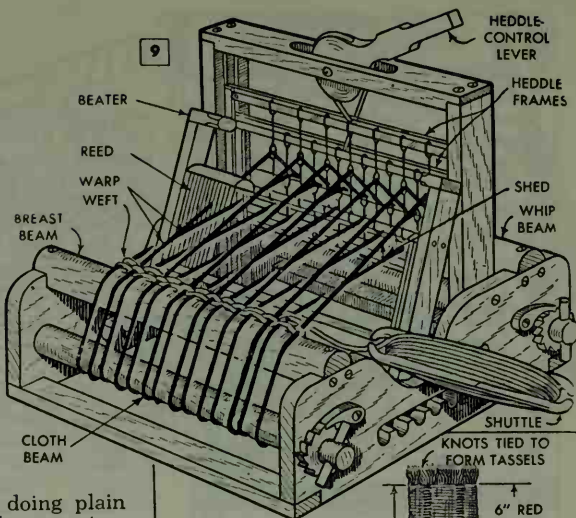
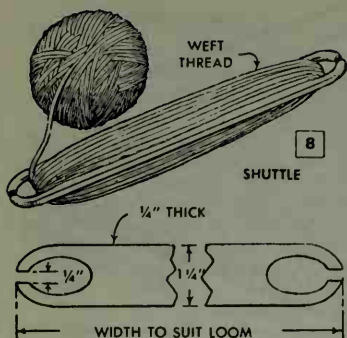
The heddle frames slide in grooves cut in the frame uprights, Fig. 4. The grooves should be about $\frac{1}{16}$ in. oversize so that the frames will slide easily. Two dimensions, one on the heddles in Fig. 3 and another on the reed in Fig. 4, must be determined from these parts. Have the parts at hand before assembling the loom. Hardwood ratchets and pawls on the rollers, Fig. 4,

are for the purpose of keeping tension on the warp threads and for rolling up the finished cloth on the cloth beam as the weaving progresses.

Fig. 2 shows methods of cutting 6 and 10-ft. warp yarn, or threads, to exact length. This done, you string the loom as in Figs. 5, 6 and 7. Notice in Fig. 5 how the odd-numbered warp threads are pulled through the heddles (C) with a threading tool made as in Fig. 6. The even-numbered threads go through the heddles (B). Both sets of threads pass over the whip beam and are wound on the warp beam at the rear of the loom. Study Fig. 9, which shows the warp threads in exaggerated size and in two colors for clarity. Also compare with the shed formed by shifting the heddle-control lever, Fig. 13, to the right-hand position as in Fig. 14. Fig. 7 shows how the ends of the warp threads are locked to the cloth beam with a spline which fits in a groove cut in the roller. Figs. 13 to 15 inclusive show the



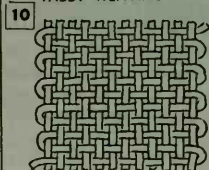
the Loom



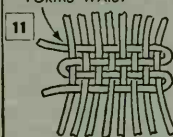
operation of the loom when doing plain weaving. Fig. 10 shows tabby weaving. Notes on the detail drawings, Figs. 13 to 15, explain the sequence of operations clearly. One thing to watch in weaving is the tendency to pull the weft too tightly. This forms what weavers call a waist, Fig. 11, and causes the woven strip to become narrower as the weaving progresses. Generally, tension on the weft must be watched more closely on coarsely woven cloth. The greater the number of warp threads per inch the less tendency there is for this fault to appear in weaving.

Fig. 12 shows a vari-colored pattern woven in a table scarf. Here variations are made in the warp threads and two shuttles are used, one carrying the red and one the blue filler or weft. Shuttles are made from a strip of hardwood with the ends shaped as in Fig. 8. Length of the shuttle should be approximately half the width of the cloth being woven, although some weavers prefer a shorter shuttle.

TABBY WEAVING



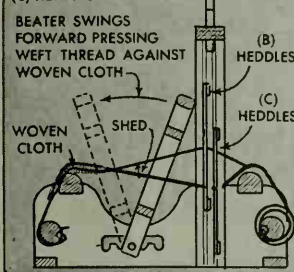
TENDENCY TO PULL WEFT TOO TIGHT FORMS WAIST



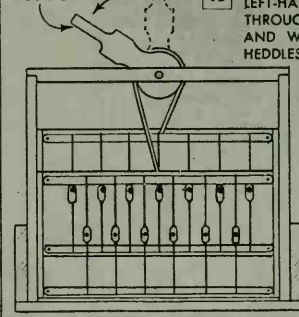
13 5 7 9
15 WARP THREADS PER INCH—ODD NUMBERS THROUGH (C) HEDDLES AND EVEN NUMBERS THROUGH (B) HEDDLES

12 WHEN HEDDLE-CONTROL LEVER IS IN LEFT-HAND POSITION, WARP THREADS THROUGH (B) HEDDLES ARE LOWERED AND WARP THREADS THROUGH (C) HEDDLES ARE RAISED

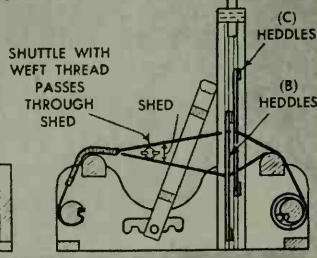
WHEN HEDDLE-CONTROL LEVER IS IN RIGHT-HAND POSITION, WARP THREADS THROUGH (B) HEDDLES ARE RAISED AND WARP THREADS THROUGH (C) HEDDLES ARE LOWERED



LEFT-HAND POSITION



SHUTTLE WITH WEFT THREAD PASSES THROUGH SHED

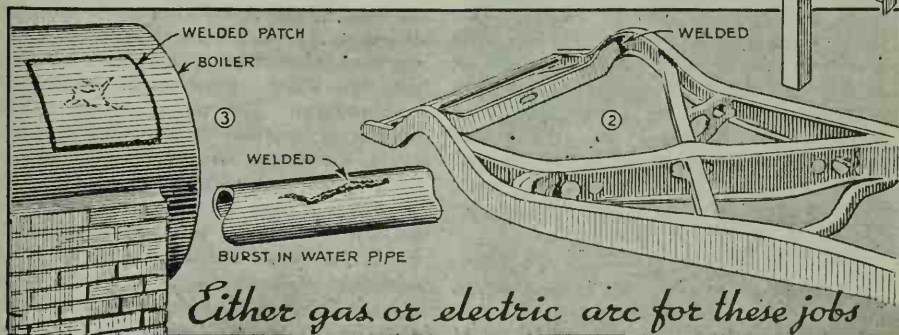
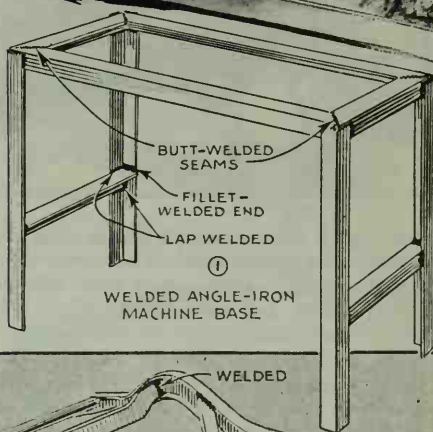


WELDING

WHEN to use the electric arc and oxy-acetylene flame for welding need not be a puzzling problem. Just remember that the arc is faster and enables you to minimize distortion, while the gas flame can be varied to control hardness of the weld. In many cases, however, either method produces results that are quite similar, thus making the choice a matter of convenience. Ordinary assembly work and repair jobs on wrought iron and mild steel, Figs. 1, 2 and 3, permit the use of either method. On other jobs, the form or thickness of the pieces at the point of weld, the kind of metal and the results desired often make one method better than the other.

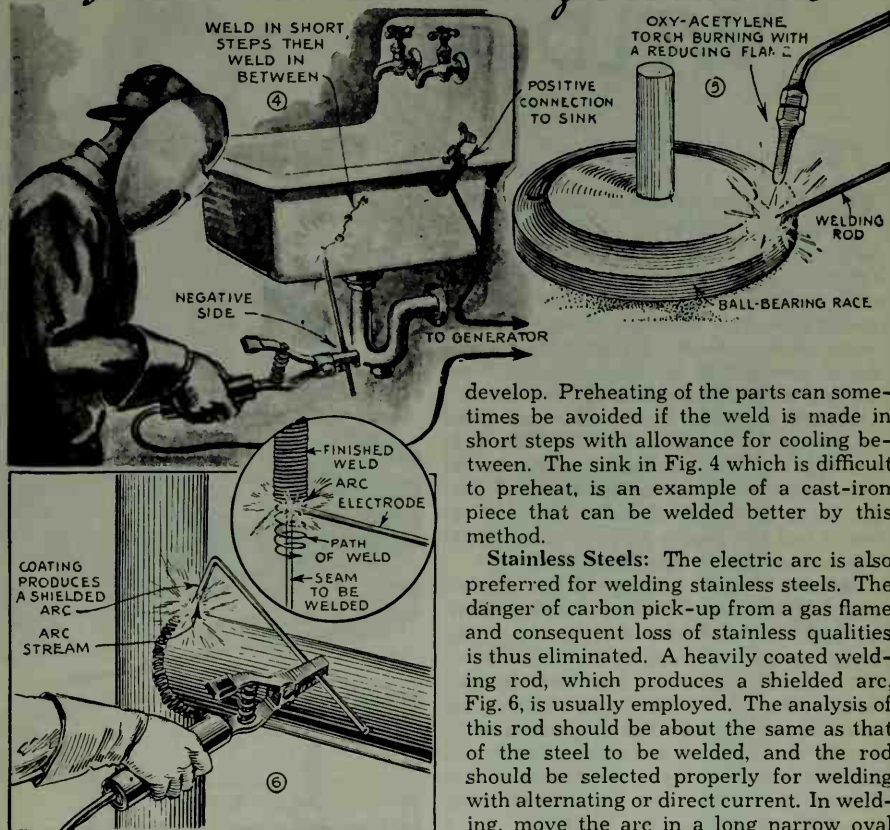
Special Shapes: In welding special shapes where distortion or warping must be kept at a minimum the electric arc is better as the weld can be finished before the surrounding metal has been heated excessively. For example, in building up a broken gear tooth, Fig. 7, speed is necessary to minimize distortion. The tooth is built up as rapidly as possible with the electric arc, after which the finished weld is machined or otherwise finished.

Hardness of Steel Welds: With the oxy-acetylene torch, a reducing flame—one with an excess of acetylene gas—can be used to control hardness of the weld. In this case, some of the excess gas is broken



Either gas or electric arc for these jobs

The electric arc minimizes distortion



develop. Preheating of the parts can sometimes be avoided if the weld is made in short steps with allowance for cooling between. The sink in Fig. 4 which is difficult to preheat, is an example of a cast-iron piece that can be welded better by this method.

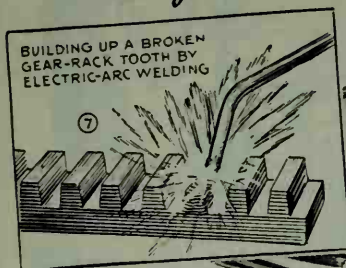
Stainless Steels: The electric arc is also preferred for welding stainless steels. The danger of carbon pick-up from a gas flame and consequent loss of stainless qualities is thus eliminated. A heavily coated welding rod, which produces a shielded arc, Fig. 6, is usually employed. The analysis of this rod should be about the same as that of the steel to be welded, and the rod should be selected properly for welding with alternating or direct current. In welding, move the arc in a long narrow oval along the seam to keep the metal molten long for gas bubbles to escape. Stainless steel expands greatly upon heating and the strains produced around a welded joint in this metal are considerable. If the piece is annealed after welding to remove these strains, the joint will be much stronger. When a direct-current arc is used, the electrode should be positive and the work negative, reversing the usual procedure.

Aluminum: This metal can be welded satisfactorily either by gas or by the electric-arc method. Gas welding on aluminum is more convenient, however, as the metal has a very low electrical resistance. In nearly all cases, preheating of aluminum parts before welding is essential when using the oxyacetylene torch, as the metal expands and contracts greatly with heat changes. Care should be taken not to pre-

down into carbon, which passes into the molten iron of the weld. This metal then becomes high-carbon steel and will be much harder and more brittle when it is cold, which is desirable in welding hard steel, as shown in Fig. 5. On the other hand, when an oxidizing flame or one with excess oxygen is used, some of the carbon in the weld metal will be burned out. The resulting weld will be softer but with a larger amount of slag on the surface, and will have a tendency to be pitted and coarse-grained. With reasonable care, however, jobs like the automobile fender, Fig. 8, can be welded successfully.

Cast Iron: The faster electric arc is better than gas welding on cast iron. Cracks due to uneven expansion of the cast iron and the weld metal are not so likely to

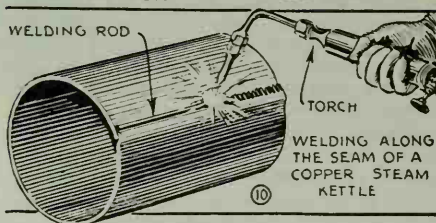
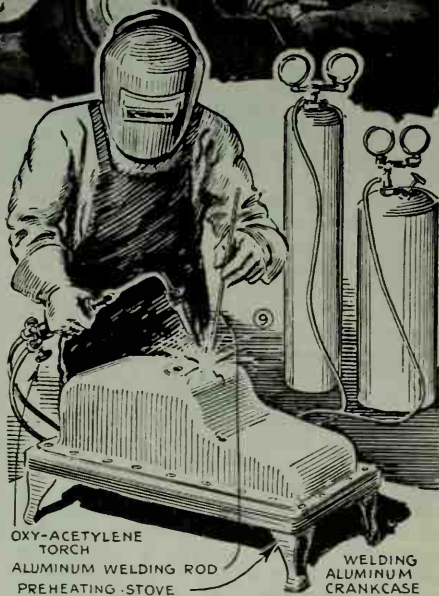
Gas welding controls hardness



heat over 800° F. as aluminum becomes very weak at temperatures above this point.

There are several methods that can be used for preheating aluminum to be welded. An open forge may be the only means available, or perhaps a gas burner is handy. The latter method is convenient when welding a cracked aluminum crankcase, which, as shown in Fig. 9, has been placed over both burners. As the determination of exact temperature of a casting may be impossible with apparatus available, you can tell approximately the correct welding temperature by simply touching a stick of ordinary solder to the metal at the welding location. Just as soon as the solder melts when it contacts the aluminum, the piece is hot enough to commence welding. Aluminum and its alloys have a sharp melting point and collapse readily into a very fluid pool around the torch flame. This may cause difficulty in welding as the molten pool can become deep enough to blow through and run off while the rod is still solid. Technique in handling the torch and rod will help, but the use of welding rods of the same alloy as the metal to be welded—cast rod for cast aluminum, duralumin for duralumin, etc.—will tend to eliminate this difficulty.

Copper, Bronze, and Brass: Since the electrical resistance of this class of metals is very low, gas welding is again slightly more satisfactory than welding with the electric arc. Results are the same, however, by either method, when the work is done correctly. Copper, bronze, and brass do not expand excessively when heated but the molten metal is very fluid. This



makes for faster fusion and often the welding can be done by simply laying a piece of welding rod along the joint or seam and flowing it in place with the torch, Fig. 10. Copper and its alloys conduct heat readily, and it is often difficult to keep the weld hot enough. Preheating the pieces will save gas and allow the welding to proceed faster.

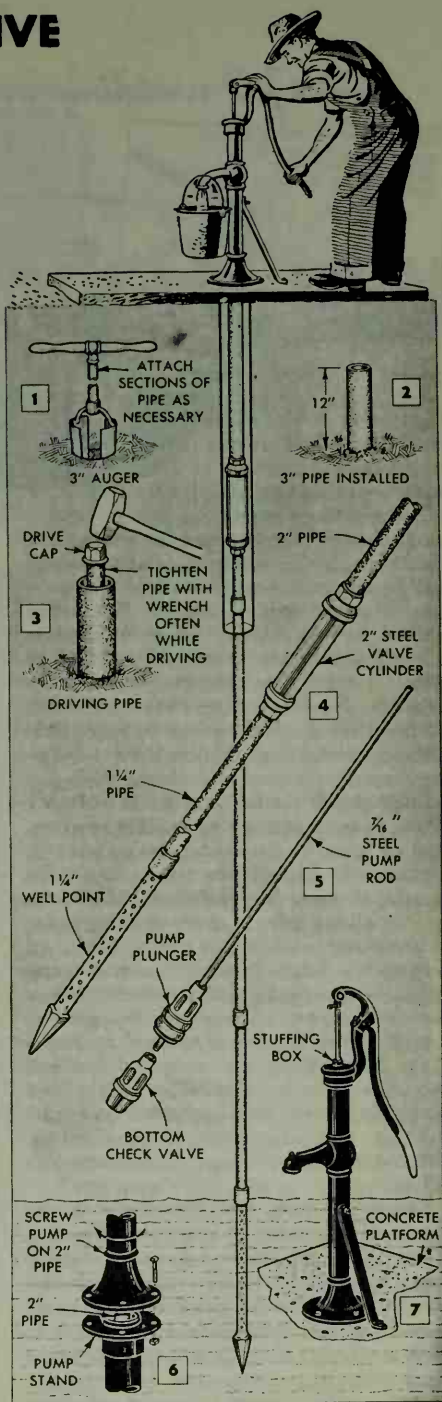
WELLS-HOW TO DRIVE

Where water-bearing strata are quite near the surface it's easy to put down a well

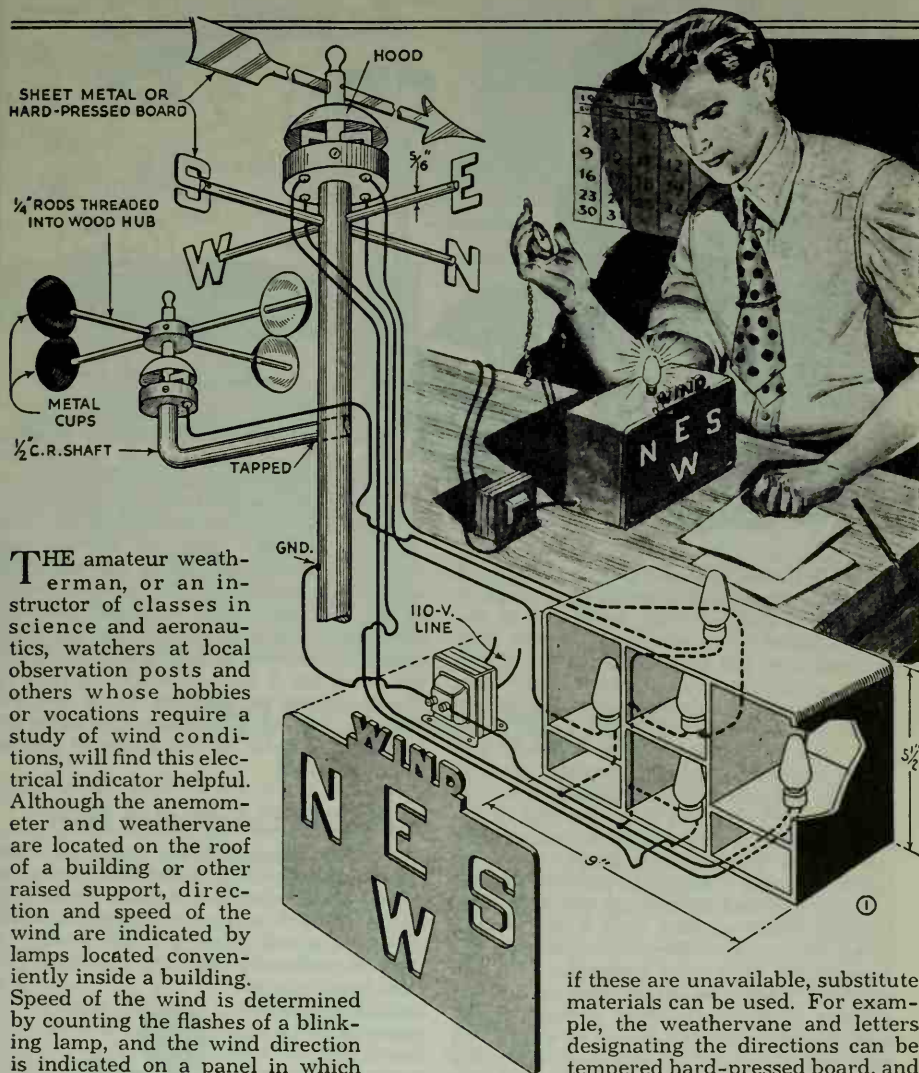
IN MANY LOCALITIES where the ground is fairly level over comparatively large areas you can generally tap a good water supply by merely driving down a pipe fitted with a well point. If you plan to drive a well you may save time by making inquiry about the depth of wells in the vicinity. Experienced well drillers often can tell with remarkable accuracy, just by the look of things, where you will be most apt to strike water with a well point and at approximately what depth. Once you have good advice on these points the rest is quite easy to accomplish.

Begin as in Fig. 1 with a 3-in. posthole auger of the type having a handle of pipe. Have at hand several 3-ft. lengths of pipe threaded to fit the handle, together with couplings. Run the auger down as far as it will go easily, then unscrew the handle, turn on another section of pipe and proceed, lengthening the auger handle in the same way until you reach a depth of 8 to 12 ft. Here the auger with its long handle becomes unwieldy and, besides, in most localities, a depth of 8 ft. will put the pump cylinder below the maximum frost depth. Now drive a length of 3-in. pipe into the auger hole to serve as a casing, Fig. 2. Next, assemble the well point and one or more lengths of pipe of sufficient combined length to reach above ground when the well point touches the earth at the lower end of the casing. Draw these joints tight. Screw on the drive cap, Fig. 3, and you're ready to go. Take it easy with the sledge, as heavy blows may buckle the pipe or have the effect of deflecting the point. As a rule the pipe drives quite easily. From there on it's merely a matter of adding pipe in short lengths until the driven point reaches water. Usually you can tell quite accurately when the point enters water-bearing strata. Check with a weighted cord lowered inside the pipe. If the point strikes a rock on the way down, it's usually best to pull it and start over again. Any attempt to force the point past a stone by heavy slogging may cause buckling.

When you're sure of water, assemble the pump cylinder, Figs. 4 and 5, and drive this down until the top end of the pipe reaches to a point an inch or so above the casing. Then install the pump as in Fig. 6 and pour a concrete platform as in Fig. 7. Slope the platform so water runs off on all sides.



WIND INDICATORS



THE amateur weatherman, or an instructor of classes in science and aeronautics, watchers at local observation posts and others whose hobbies or vocations require a study of wind conditions, will find this electrical indicator helpful. Although the anemometer and weathervane are located on the roof of a building or other raised support, direction and speed of the wind are indicated by lamps located conveniently inside a building. Speed of the wind is determined by counting the flashes of a blinking lamp, and the wind direction is indicated on a panel in which the letters N, E, S and W are jigsawed. A lamp behind each letter lights up whenever the weathervane, which acts as a switch to close the electrical circuit, points in the direction designated by one of the letters.

Although construction of the indicator may seem difficult at first glance, it is quite easy. Naturally, steel shafting is best for the main standard and the arm supporting the anemometer, and brass or copper is best for the rest of the exposed parts, but

if these are unavailable, substitute materials can be used. For example, the weathervane and letters designating the directions can be tempered hard-pressed board, and the small rods supporting the letters and also the anemometer cups can be hardwood dowels. Also, it is possible to use wood for the standard and arm. If this is done, short shafts must be inserted in their upper ends to provide bearings. And, of course, the short rotating shafts of the vane and anemometer must be metal to withstand wear. If regular spun-metal wind cups for the anemometer are unavailable, the bowl parts of large spoons will serve, but they all must be of the same size and shape.

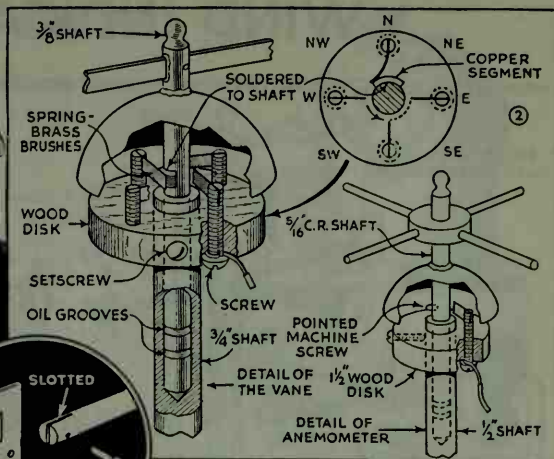


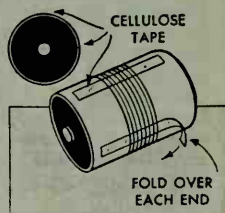
Fig. 2 shows how the pointed shafts of the anemometer and weathervane work in the drilled ends of their standards to reduce friction to a minimum. Notice that grooves near the lower ends of the shafts serve as oil reservoirs, which make frequent lubrication unnecessary. Reference to the left-hand detail of Fig. 2 will show you how to construct the weathervane brush assembly, which consists of four brushes mounted on a wooden disk, the latter being locked on the upper end of the standard with a setscrew to permit adjustment. The brushes are strips of spring brass or copper clamped in the slotted ends of screws turned up through the disk. The brushes make contact with a single-segment commutator sweat-soldered to the vane shaft. It is very important that the segment width be equal exactly to one quarter of the vane-shaft circumference, and that the segment center be exactly in line with the vane. In this way, when the indicator is wired as in Fig. 1, only one lamp will show on the indicator panel when the vane points north, east, west or south, as the commutator contacts only one brush. But, if the vane points between two of these directions, the brush will contact two adjacent brushes and two lamps will show. For example, a northeast wind would cause the north and east lamps to show. A sheet-metal hood protects the brush assembly.

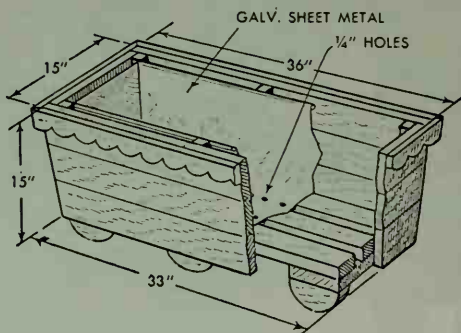
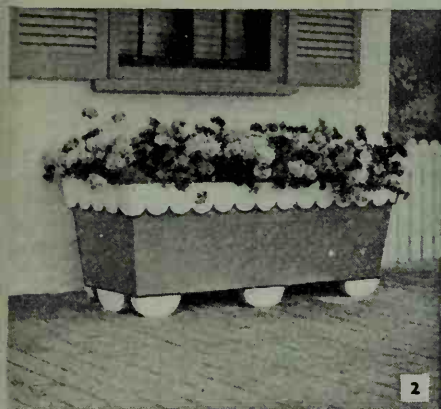
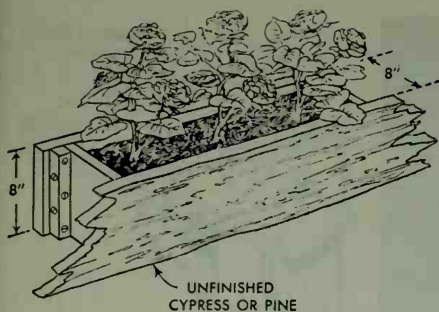
Construction of the anemometer mounting and brush assembly are similar to that for the vane, except that only one brush is used, and the commutator consists of a

pointed screw. One contact is made for each revolution, thus causing the lamp to flash once for each revolution. The easiest way of calibrating the anemometer is to fasten it above the front of a car and drive on a calm day, counting the revolutions of the anemometer at various speeds. This data is recorded on a scale, which is placed near the indicator to aid in computing the wind speed by anyone counting the flashes of the lamp for 1 min. Electric current for the indicator is supplied by a 6-8-volt transformer, and Christmas-tree bulbs and sockets are used for the lamps at the indicating panel.

Improved Coil-Winding Form

When winding coils for radios or other apparatus, a flashlight cell with a cardboard covering can be used as a form. Space four strips of cellulose tape at regular intervals around the cell, placing them lengthwise with the adhesive side up. The length of the tape strips should be slightly more than twice the width of the proposed coil. When the desired number of turns has been tightly wound over the tape, the loose ends of the tape are folded back over the coil and pressed firmly down to keep the winding in shape while it is being handled. The finished coil can be removed by slipping the cardboard cover off the cell and collapsing it enough so that it may be easily withdrawn from the coil.





WINDOW BOXES

HANGING gardens placed at the window-sill level are of immense decorative value to both the interior and exterior of any home. Foliage and flowering plants, certain dwarf shrubs, evergreens, potted slips, succulents, and even trailing vines can be grown in a window-sill garden and they will thrive with a minimum of care. Some varieties grow best in full sunlight; others do well in partial shade, and some in full shade. This means that, by carefully selecting the plants, you can grow luxuriant hanging gardens on all four sides of the house in a single season. Groups of plants selected for a given location should have the same or similar soil preferences, and also similar temperature and sunlight requirements. Only low-growing plants with heavy stems and short foliage should be selected for second-floor window gardens, as these will be more directly exposed to high winds and beating rains. If shelves are used at the second-story windows, holes should be scrollsawed in the shelf boards so that the plant pots can be set in the holes to about half their depth.

This arrangement prevents the potted plants from being blown off the shelves. If soil is to be placed directly in the box, the latter should be made of wood with a removable metal lining of zinc or aluminum. Cypress is the most durable wood, with redwood and pine a second choice. The selection and preparation of soils are important. As the amount of soil is limited by the size of the box, the plant food of an ordinary soil will soon be depleted. A good mixture for window boxes is composed of dark garden loam, rotted leaf mold and sand in the proportions of 2 parts loam, 1 part leaf mold and 1 part sand. After these components are mixed, a complete fertilizer is added. Then the whole mass is mixed thoroughly and sifted through a $\frac{1}{2}$ -in.-mesh screen. To grow most varieties of succulents, proportions of the soil mixture should be 2 parts loam to 1 part coarse sand, no leaf mold being used.

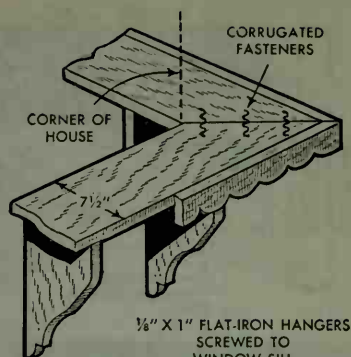
In preparing the window box for planting, $\frac{1}{2}$ -in. drainage holes are drilled in the bottom in an over-all pattern measuring about 3 in. each way. Small pieces of



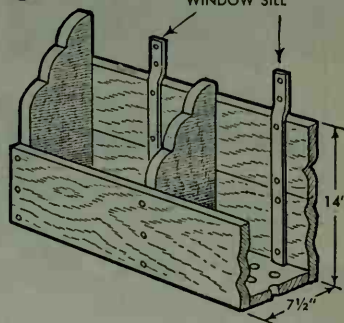
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4



7 1/2"
 1/2" X 1" FLAT-IRON HANGERS
 SCREWED TO
 WINDOW SILL

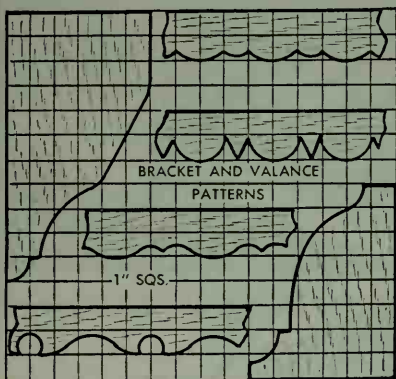
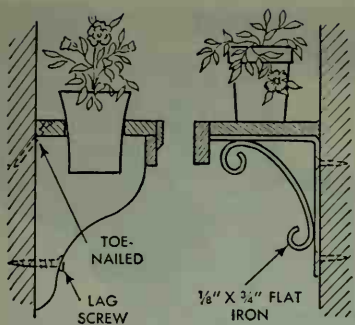


broken pottery (pieces from a flowerpot will do) are placed over each of the holes to keep fine material from sifting through. Then a 1-in. layer of coarse gravel, cinders or small pieces of broken pottery is placed in the bottom of the box. If the box is to be planted with succulents, the layer of this material should be 2 in. thick. Fill the box with the soil mixture to within about 1/2 in. of the top, pressing it down firmly. The mixture should be dry enough to handle easily without sticking to the fingers.

Plants to be grown in such a confined space as the average window box should be selected for type and habits of growth. Foliage plants with large individual leaves should not be planted adjacent to small, low-growing plants, except in extra-long boxes where the large plants can be placed at the ends of the box or in the center. If planted at random or alternately in a smaller box, the large leaves of the taller foliage plant will shade the smaller plants during some part of the day and may thus affect the rate and extent of growth. As a result of spreading root systems, large and vigorous growers also will rob small plants of needed soil fertility. Window-box gardeners generally select low-growing flowering plants for the sunny side, foliage

plants and trailing vines for the areas of partial and full shade and small evergreens for the year-round window garden. Suitable evergreens may be any of the low, spreading varieties which grow slowly. Certain plants that will not mature fully in the shorter growing seasons of the colder regions are suitable for outside plantings only in the warmer climates.

Most window-box plantings must be sprayed or dusted regularly to keep off insects and prevent disease. Spray solutions can be applied with a syringe, and prepared dusts with an applicator usually furnished with the product. As a rule, only annuals are planted in outside window boxes in temperate regions. In most cases, potted plants placed in or on window boxes or shelves are taken inside during the colder months. This simplifies the insect and disease-control problem, at least to some extent. Plantings of evergreens that are well established will flourish the year 'round in exposed locations if they are properly cared for during the summer and are thoroughly watered just before the coming of freezing temperatures. At this time, a thorough watering is especially important for if the soil freezes "dry" the plants are likely to die.

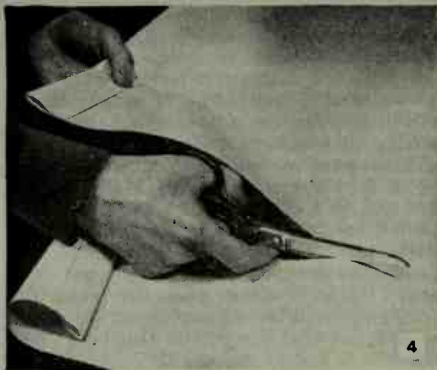
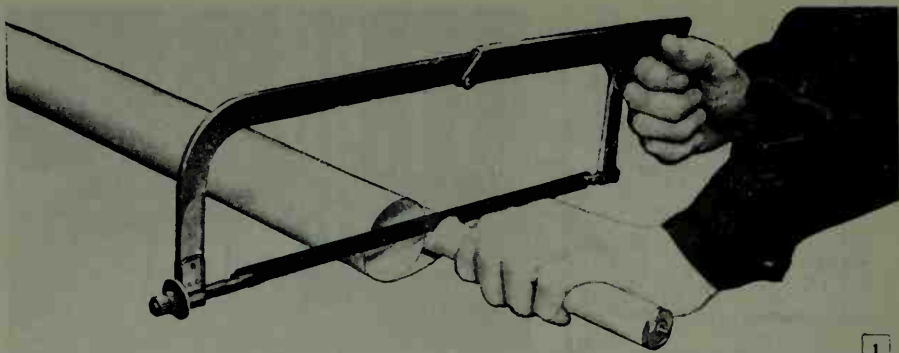


Window boxes and shelves pictured and detailed in Figs. 1 to 5 inclusive are designed for mounting outside the window. Those shown in Figs. 6, 7 and 8 are built as a part of the house and, in the warmer climates, can be used for plantings of perennials. Shelves are supported on bandsawed brackets and decorated with an edging or valance in a scrolled design as shown on the corner shelf in Fig. 3. Several scroll-sawed designs for brackets and edgings are shown in the crosshatched detail above. The shelf in Fig. 5 is supported by flat-iron scrolls which are especially attractive when used on walls of white siding or stucco. When shelves are attached to the wall with brackets, the inner edge should be set out from the wall about $\frac{1}{4}$ to $\frac{1}{2}$ in. so that water and dirt do not collect at this point. Use brass screws for fastening the brackets to wooden walls and masonry drive nails or expanding fasteners on masonry walls. In either case, the fastenings should be sufficiently strong to support the weight of the box when it is full of damp soil.



WINDOW SHADE

IF YOU FIND, when remodeling a room in your home, that the window shades no longer fit windows that have been made smaller, try cutting them down yourself before you buy new ones. First, take measurements of the cut-down window casings. If a shade is to be installed inside the casing, measure exactly the distance across the opening where the brackets are to be placed and subtract $\frac{1}{8}$ in. to allow for bracket clearance. If installing the shade outside the casing, add 3 in. to overlap at the sides. The length of the larger shade may be retained, as it will provide extra material should the shade tear at the roller at any time. Now, unroll one of the shades on the floor or, preferably, across the top of a large table, measure off the desired width with a yardstick and make a pencil mark. Make similar marks to enable you to draw a straight line connecting them, pictured in Fig. 3. Be sure to measure the shade so that you cut off the end fitted with a metal cap and pin rather than the end containing the spring mechanism. After removing the stick from the end of the shade, cut along the line, as demonstrated in Fig. 4, using scissors or a razor blade and metal straight-edge. This done, use a hacksaw to cut the roller and stick to the proper length, as in Fig. 1. Now, remove the pin and cap from the cutoff end of the roller, using pliers to extract the pin. Fit the cap over the newly cut end of the cut-down roller and drive in the pin with a hammer. Replace the stick and attach a pull cord to the end of the shade. In replacing a worn shade, place the old shade alongside a newer, larger one and use it for measuring, as shown in Fig. 2.



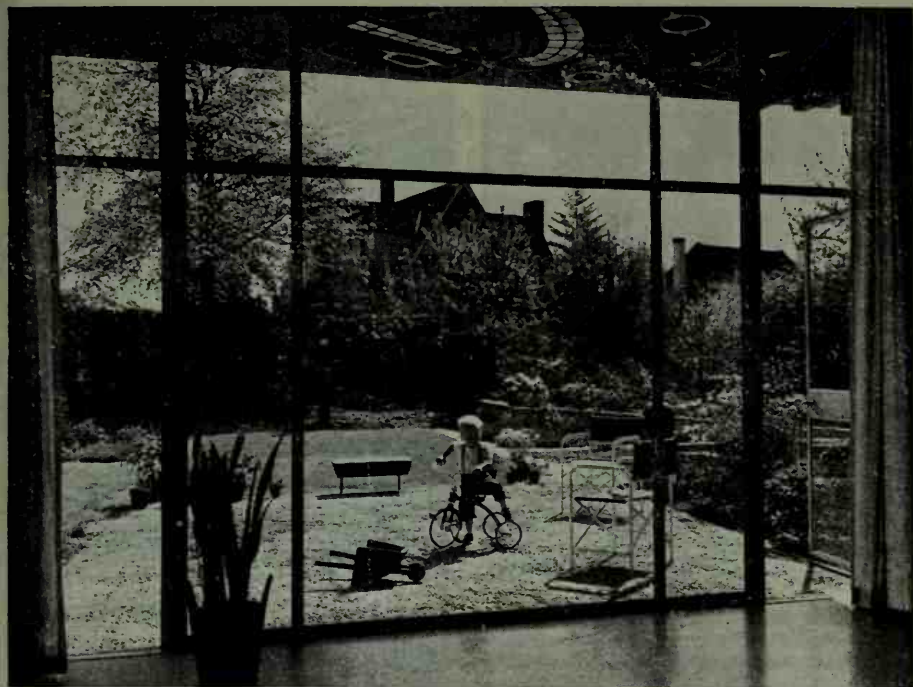


FIG. 1

Photo courtesy Libbey-Owens-Ford Glass Co.

Large expanses of picture windows tend to project your rooms toward the outdoors and give the illusion of more space. A picture window is intended also to produce an attractively framed scene both from inside and out

WINDOWS

WHEN MODERNIZING YOUR HOME, the right kind of windows properly located and installed can work wonders in improving appearance and providing more comfort. Today's windows are vastly improved over those of only a few years ago, eliminating and minimizing many troubles inherent in the older designs.

Improved modern windows: Figs. 1 to 5 show a variety of modern windows. Improved features include quickly removable sash of double-hung windows, and new methods of counterbalancing sash, which eliminate sash cords, weights and pulleys. Besides wood windows, numerous metal windows have been developed. Some of these are rustproof and are precision-fitted to reduce filtration of air without sacrificing ease of sash movement. Among the developments in glass are glare-reducing, heat-absorbing and also insulating glass.

There are four types of windows: (1) Windows having vertically or horizontally

sliding sash. The former also are called "double-hung" windows. (2) Casement windows, which are hinged at one side, and other windows such as centrally pivoted and folding "flue" styles. (3) Awning and louver-type windows of which the sash or panes swing outward on a horizontal axis. (4) Stationary windows in walls and roofs, Figs. 1, 3 and 22.

Sliding-sash windows: Double-hung windows, so called because the counterbalanced sash that slide vertically are "hung" in a casing, are shown in Figs. 5 to 7. On many windows of this type you can quickly remove either the upper or lower sash, Fig. 6, to facilitate washing them. Some window casings have three or four channels, two for the regular sash, and added ones for screen and storm sash. Double-hung windows can be provided with divided screens and storm sash, which are easily put in position or removed like regular removable sash. Fig. 7 shows a double-hung, aluminum window



FIG. 2 Photo courtesy Andersen Corp.

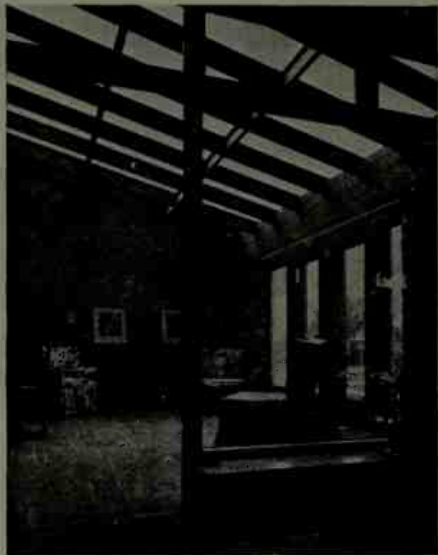


FIG. 3 Photo courtesy Libbey-Owens-Ford Glass Co.

and details of its construction. Windows that have horizontally sliding sash, Fig. 8, are very similar in construction to double-hung windows, but differ in that they do not require any counterbalances.

Spring and friction counterbalances: Spring counterbalances and other methods of employing friction eliminate the need of sash weights, cords and pulleys on double-hung windows. The spring counterbalance shown in Fig. 10 comprises a narrow, enclosed, spring-actuated drum on which a thin, steel tape winds or unwinds. One kind is designed chiefly to take the place of sash-cord pulleys, and another is intended for overhead installation on new windows. The end of the rust-resistant tape is hooked to the edge of the sash, in a recess. One counterbalance of this kind is required for each sash.

Another counterbalance, shown in Fig. 11, consists of a long coil spring enclosed in a narrow sheet-metal housing of which the length equals the height of the casing. Two such counterbalances are used for each sash, the edges of the sash being grooved to accommodate them. Because of this manner of installation the balances also serve as efficient weatherstripping. There are a number of other counterbalancing methods that work on the principle of controlled friction. These may be spring-pressured slides on either side of the sash, or strips that wedge the sash against the parting or stop strips of the casing when a thumb lever is released.

Casement windows: Modern casement windows, such as shown in Figs. 2 and 9, of



FIG. 4 Photo courtesy Gate City Sash & Door Co.



FIG. 5 Photo courtesy Curtis Companies, Inc.



FIG. 6 Photo courtesy R. O. W. Sales Co.

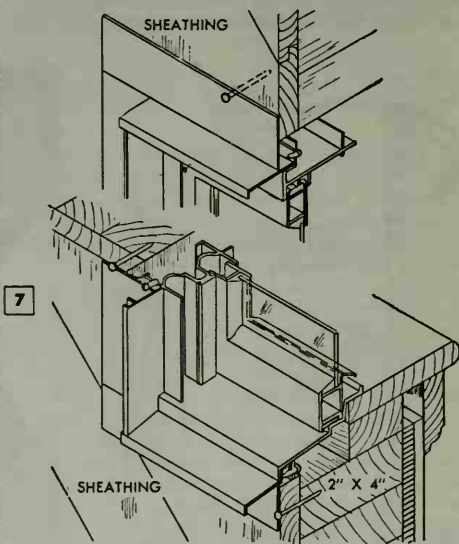
wood or metal generally are installed to swing outward. The windows are opened and closed by means of a crank or lever, which also holds the sash securely in any open position. When closed, a fastener locks the sash and holds them tightly against the casing stops. Offset or double-acting hinges on casement windows bring the hinge edge of the sash far enough away from the casing to facilitate washing the outside of the panes as shown in Fig. 9.

Screens and storm sash usually are fitted to the inside of casement windows. An exception to this method is fastening the

storm sash on the outside of the windows, Fig. 9. Some storm sash have a section that opens for ventilation. Either rigid or roll-type screens can be used. Casement windows offer excellent ventilation as they can be opened entirely from top to bottom. The sash can be set at an angle to divert moving outside air into the house. A disadvantage is that when these windows are not shielded by overhanging eaves or by canopies, rain can get into the house.

Awning-type windows: Awning-type windows such as shown in Fig. 4 have a number of sash that swing outwardly to any angle up to about 90 deg. for maximum ventilation. The sash are pivoted at their top edges. They often work in unison, being connected together with links actuated with a lever or crank, but some have sash that can be manipulated individually. The tilted sash normally prevents rain from getting inside. Each sash must be completely weatherstripped all around in cold climates. Screens and storm sash are applied on the inside.

Louver-type windows: Also known as "jalousies," louver-type windows, Fig. 12, operate on the same general principle as awning-type windows, but differ in that they have narrow panes of thick glass. When the window is closed the panes overlap each other. All open simultaneously at any angle up to 90 deg., by means of a lever or crank. They are most popular in moderate climates where a tight seal against air filtration is not essential. They are also



DOUBLE-HUNG ALUMINUM WINDOW FOR FRAME OR BRICK-VENEER CONSTRUCTION

Photo & illustration courtesy General Bronze Co., Alwintle Div.

popular for use on porches. The panes of glass are held in channel-shaped, spring-clip holders of metal, and these are usually pivoted centrally to vertical side plates. Screens or storm sash can be installed on either side if clearance is provided.

Framing: The tops of windows usually are lined up with the tops of doors for appearance. Before installing a window casing, an opening is made in the wall and framed as shown in Fig. 13. The exact size of the window casing should be known beforehand so that the right amount of clearance between it and the framing can be provided. The clearance varies with the particular type of window used according to the manufacturer's recommendations.

The opening for a window is framed with double thicknesses of 2 by 4-in. stock for greatest strength and rigidity. The double header at the top should be set on edge with a $\frac{3}{8}$ -in. filler block between the pieces to bring them flush with studs. For openings over 5 ft. wide it is best to use 2 by 6-in. or wider stock for the double header at the top. Added strength can be provided also by trussing as shown in Fig. 14. The short studs above and below the headers, called "cripples," should be located on 16-in. centers with other studs.

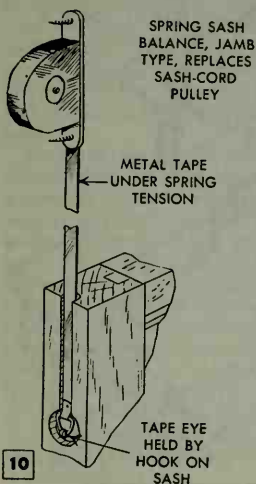
Bay windows: Where a bay window is desired, it can either be part of the house wall built up on an extending part of the foundation wall, or it can be supported on extending floor joists as shown in Fig. 15. When remodeling to include a bay window, you can nail on extra pieces to extend from the joists, or you can secure the floor framing of the bay window to the house wall like



FIG. 8 Photo courtesy General Bronze Co., Alwintite Div.



FIG. 9 Photo courtesy Season-all Sales Corp.



10

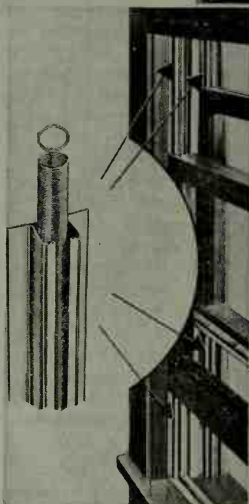
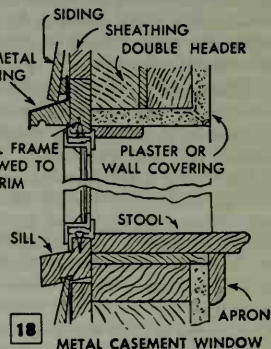
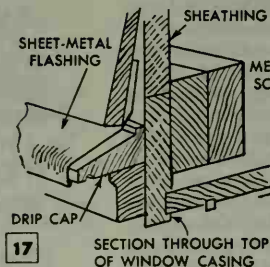
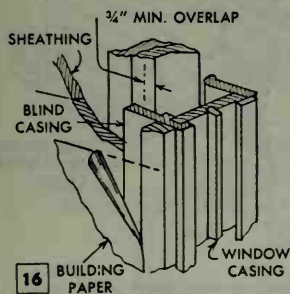
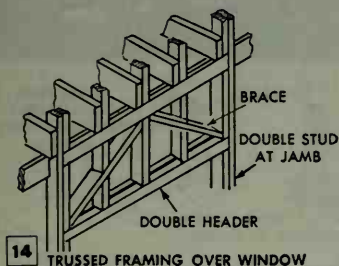
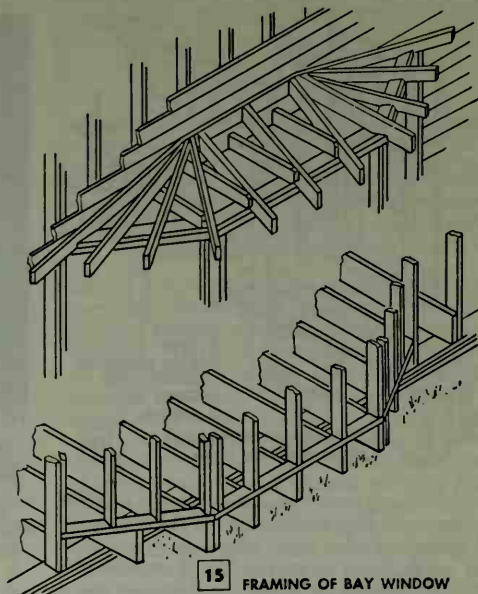
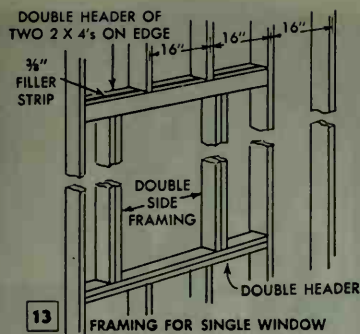


Photo courtesy Master Metal Strip Service
FIG. 11



FIG. 12 Photo courtesy Sun-Sash Co.



a wood porch floor. The roof framing for a bay window built on a house of frame construction is also shown in Figure 15.

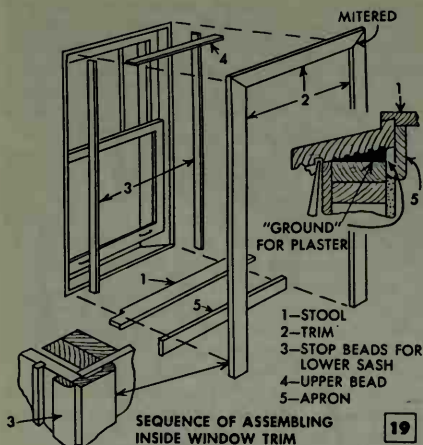
Installing casings: To install a window frame or casing it is inserted into the framed opening from the outside. The blind casing should come over the edge of the framing not less than $\frac{3}{4}$ in., as shown in Fig. 16. Next, the casing is adjusted level and plumb by means of wood wedges such as shingles. These are driven between the frame and the casing from the inside, at the sides and bottom, just tight enough to hold the casing in position. When plumb, you nail the blind casing to the framing.

Casings that have spring counterbalances can be nailed to the frame with finishing nails driven through the wedges on both sides. This, however, cannot be done on older windows having a well for sash

weights. Building paper is laid over the joint between the sheathing and the blind casing before the outside wall covering is applied. Casings for use on brick-veneer walls but the basic method of installation is similar to that described. A drip cap usually is included at the top of a casing as in Fig. 17. This should be covered with rust-resistant, sheet-metal flashing, brought up under the siding, clapboard or shingles.

Fig. 18 shows a cross section of a casement window installed on frame construction. On brick veneer, angle-iron lintels are used to span the top of the window opening. Metal casement windows often are screwed to a wood frame first, which then is installed in the window opening. On some metal windows projecting fins serve the purpose of flashing.

Inside trim: On a wood window of the



double-hung type the inside trim is applied as shown in Fig. 19. This gives the sequence of installing the trim which is done after the walls have been plastered or covered with wallboard. Instead of nailing on wood trim, you may prefer to use sheet-metal snap-on trim which is made by a number of manufacturers.

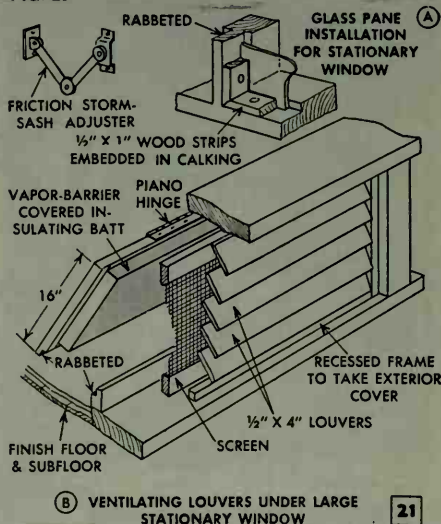
Stationary windows: Exceptionally large windows are generally stationary. The casing of a stationary wall window is rabbeted to accommodate the glass panes which are imbedded in putty or calking compound. Stop strips, similarly imbedded, are placed against the pane and are nailed on from the outside as in Figs. 20 and 21-A. Panels of glass over 5 ft. high or wide should have a $\frac{1}{4}$ -in. clearance at one side and top, between the pane and the casing. On large windows it is often advisable to use insulating glass, which eliminates the need of storm sash. Special precautions must be taken when installing this glass as discussed under "Insulating glass."

Where a room lacks ventilation because of large stationary windows, you can install screened, louver-type ventilators under them as shown in Fig. 21-B. Such ventilators may be tightly closed on both sides during cold weather. They can be fitted with insulation and a vapor barrier. If the height of the door is 18 in. or so, a standard insulating batt can be attached to the inside as shown. The door is hinged at the top edge and opens from the bottom. It can be adjusted to any open position and held there by means of friction-type storm-sash holders.

Glass-block windows: Windows made of glass blocks, as shown in Fig. 22, are strikingly modern. They also have excellent insulating value since the blocks are hollow and the space inside is partially evacuated



FIG. 20



(B) VENTILATING LOUVERS UNDER LARGE STATIONARY WINDOW

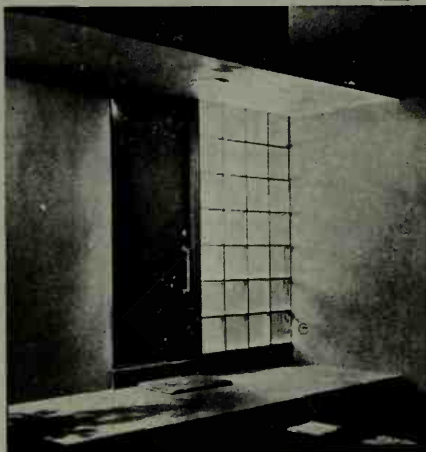


FIG. 22

Photo courtesy Pittsburgh Corning Corp.



23

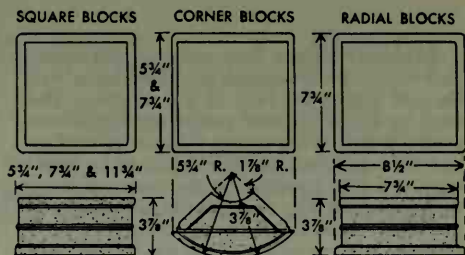
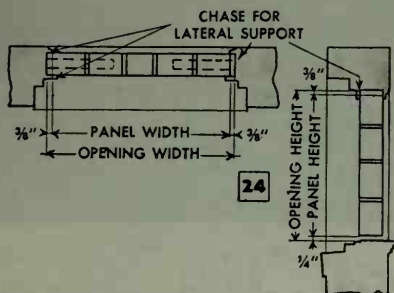
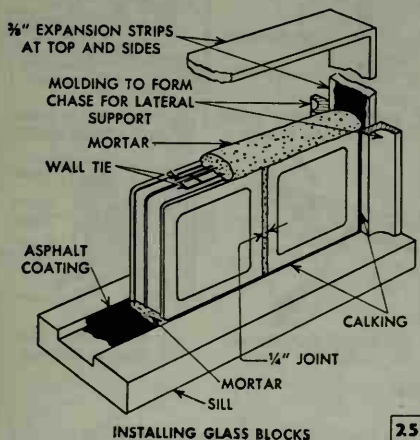


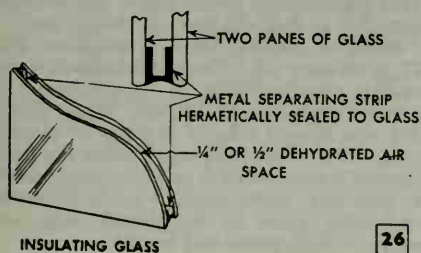
Photo & illustrations courtesy Pittsburgh Corning Corp.



24



25



26

of air. Glass blocks are available in many patterns. Some are transparent for visibility and others are translucent to provide privacy. An individual glass block is shown in Fig. 23, which also gives the sizes and shapes available. Where an opening for ventilation is needed in a glass-block window you can install a small metal window to bridge two courses. Individual glass blocks that come on hinged frames are also available for this purpose.

Glass blocks should never be used for load-bearing walls. The weight over glass-block windows should be carried by suitable lintels or girders. The size of an opening to accommodate glass blocks should be equal to their dimensions plus the space required for joints and for the expansion strips. Lateral support for side and top edges of a glass-block window usually is provided by forming a chase as shown in Figs. 24 and 25. This forms a channel into which the blocks fit. A chase may consist of channel iron, angle iron or wood molding of suitable size.

Installing glass blocks: The entire perimeter of the opening in which glass blocks are to be installed is given a heavy coat of asphalt emulsion over the area to be covered with mortar as shown in Fig. 25. If the openings are larger than 25 sq. ft., and if the height exceeds 7 ft., or the width exceeds 5 ft., expansion strips are installed at the jambs and head of the frame while the asphalt coating still is tacky. For openings smaller than this only an expansion space of 1/4 in. at the top is necessary.

After placing mortar on the sill to produce a 1/4-in. bed besides filling the concavity in the block, you lay the first course. Space the blocks 1/4 in. apart, and completely fill the vertical joints with mortar. You can use ready-mixed mortar, which requires only the addition of water. It should be mixed to a stiffer consistency than mortar used for brickwork. The blocks should be adjusted carefully so the top edges and faces are in perfect alignment. Steel tools should not be used to tap blocks into position. Light-diffusing and light-directing blocks can be set in one position only, each block being marked to indicate this.

After laying the first course, you apply half of the next mortar bed. Then lay a wall tie and apply the rest of the mortar. The wall tie should extend across the blocks the entire width of the glass. Where more than one tie is needed, the joints should be overlapped 6 in. Continue in the same manner to lay succeeding courses. Strike joints to get them smooth while the mortar is still plastic. Also rake out along the bottom and sides for calking. Remove surplus mortar from the faces of the blocks and wipe them dry. Final cleaning of the glass is done after the mortar has hardened.

Window glass: Ordinary window glass comes in two thicknesses; single strength (SS) for panes up to 12 by 16 in. in size, and double strength (DS) for panes up to 36 by 48 in. Double-strength glass is used generally for metal sash. Window glass comes in four grades; AA, which is specially selected quality, A grade, B grade and "green-house" grade.

Heavy sheet glass or crystal glass comes in $\frac{3}{16}$, $\frac{7}{32}$ and $\frac{1}{4}$ -in. thicknesses, and in the AA, A and B grades. It is considerably stronger than regular window glass and costs considerably less than plate glass. For the $\frac{3}{16}$ and $\frac{7}{32}$ -in. thicknesses, the pane size should not exceed 76 by 120 in. and for the $\frac{1}{4}$ -in. thickness, the pane size should not exceed 68 by 100 in.

Decorative glass and plate glass: Patterned glass from $\frac{1}{8}$ to $\frac{7}{32}$ in. thick, in many patterns and textures can be used to diffuse illumination, obscure vision and serve decorative or functional purposes.

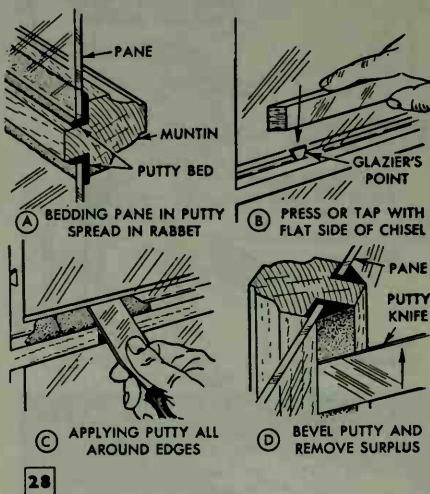
Polished plate glass provides clear vision with minimum distortion. It comes in many thicknesses from $\frac{1}{8}$ to $1\frac{1}{4}$ in. Heat-absorbing plate glass, which is pale bluish-green in color, and comes $\frac{1}{4}$ in. thick, transmits 46.8 percent of the total solar radiation as compared with the transmission of 82.3 percent of regular $\frac{1}{4}$ -in. clear plate glass.

Insulating glass: This glass, detailed in Fig. 26, minimizes the transfer of heat and cold, and eliminates the need of storm sash. It consists of two panes separated by a gap, but hermetically sealed at the edges to a metal separating strip. Non-hardening, knife-grade glazing compound — not the usual putty — is used to bed this glass. It is supported on soft "setting" blocks or special glazing clips.

The bedding should be $\frac{1}{8}$ in. thick on either side of the glass, and not less than $\frac{1}{8}$ in. under the edges so that it will not come in contact with the sash. The rabbets in which the glass is set must be deep enough to conceal the metal separating strip and also provide space for setting blocks or clips. If the width and height

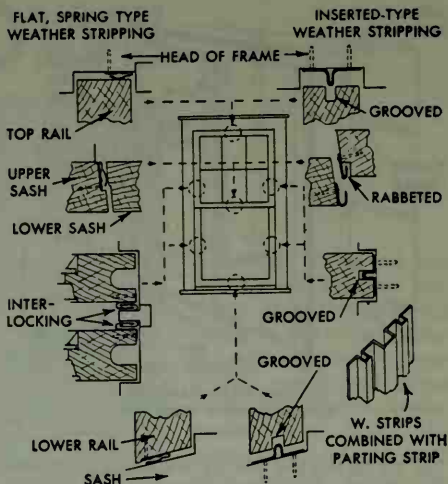


FIG. 27

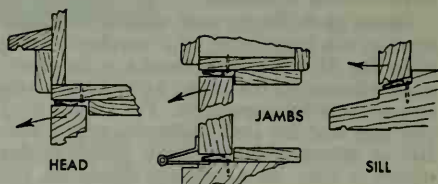


of the pane add up to more than 80 in., the clearance between the glass and the bottom of the rabbet should be $\frac{1}{4}$ in. all around. This glass cannot be cut down to size when installed as this will damage the air seal.

Steps in glazing: Glazing windows, Fig. 27, is an easy job. The procedure on wood sash is shown in Fig. 28. It is painted or primed with linseed oil first. When this is dry you spread a layer of putty or glazing compound in the rabbet and press the pane against it as in detail A until the putty starts to ooze out. Some putty is made for wood sash only, some for metal sash only, and some for both metal and wood.



30 TWO TYPES OF WEATHER STRIPPING FOR WOODEN, DOUBLE-HUNG WINDOWS



31 COMPRESSION-SPRING WEATHER STRIPPING ON WOODEN CASEMENT WINDOW

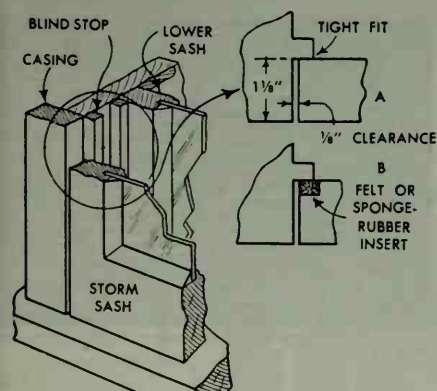


FIG. 32

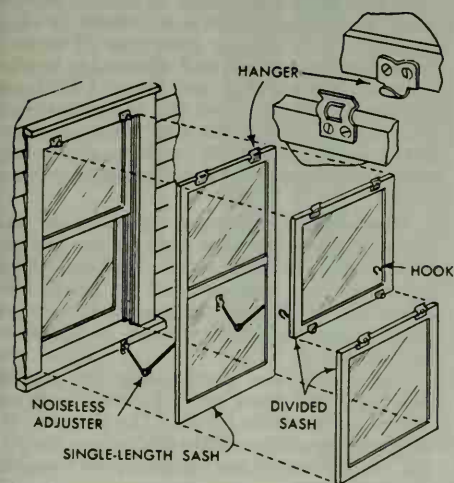
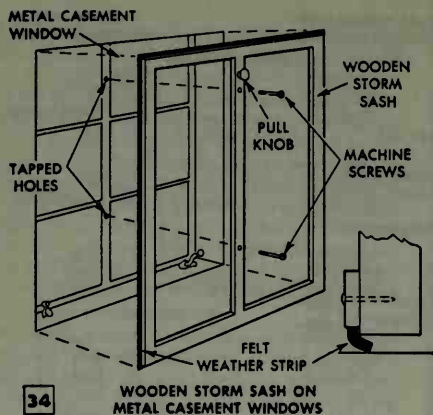


FIG. 33

The pane should be about $\frac{1}{8}$ in. smaller than the opening. On wood sash you use glazier's points to hold the pane in place. Press or tap them into the wood about 4 in. apart, using the flat edge of a chisel as in detail B. On metal sash you use spring-type wire clips. After the points or clips are applied, you apply putty, detail C, then press it down and bevel it neatly with a putty knife as in detail D. You can prevent putty from sticking to a knife by wiping it with a turpentine-moistened rag. When the putty surface is dry you paint it, allowing the paint to overlap on the pane slightly. Metal beading strips, imbedded in putty, are sometimes used on the outside of windows. Some metal windows are designed to take snap-on glazing beads over putty.

Weatherstripping: Window joints can be made to fit tightly and thus minimize air leakage by applying weatherstripping. On double-hung wood windows metal strips are nailed in the channels on either side of the sash as shown in Fig. 29. Two types of weatherstripping for double-hung wood windows are shown in Fig. 30. The inserted type requires grooving of the frame. Compression-type weatherstripping is installed on casement windows as in Fig. 31. Parts of



the strips are cut out for window catches as necessary. There are various types of fabric, felt and rubber weatherstripping which are also easy to install.

Storm sash: Storm sash should fit snugly against the blind stop of a window casing as in Fig. 32, but should have a $\frac{1}{8}$ -in. clearance all around the edges as in detail A to compensate for expansion. For a tight joint you can seal the sash along the edges with felt or sponge-rubber strips, detail B, for which it may be necessary to rabbet the edges.

Storm sash in full width or in half widths can be used on double-hung windows as shown in Fig. 33. The half widths can be passed through opened windows thus eliminating the need for a ladder. Usually storm sash are held with hangers that are permanently attached to the window casings as in Fig. 33, and are used to hold screens also. Noiseless, friction-type sash adjusters allow sash to be swung outward for ventilation. Vent openings in sash that cannot be swung out can be provided with pivoted or sliding covers.

Storm sash for casement and awning-type windows are generally installed on the inside as shown in Figs. 34 and 35. Those that cover only individual sections of metal windows do not prevent condensation from forming on the frames. Where much of this trouble is experienced it is better to install storm sash of wood that cover window openings completely as in Fig. 34. Rubber or felt strips at all edges of such sash wipe against the top, sides and sill of the casing and thus provide a tight seal.

Window screens: You can obtain metal combination units consisting of storm sash and screens, which are installed in the frames of existing double-hung windows. This arrangement eliminates the storage problem of sash and screens.

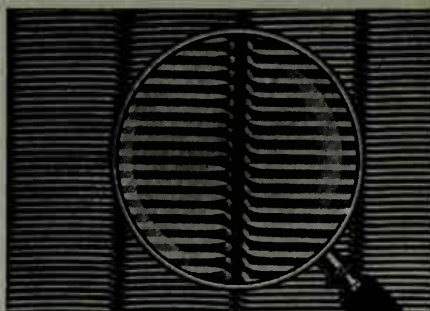


Photo courtesy Kaiser Aluminum & Chemical Sales, Inc.

Besides the usual galvanized-iron screen, you can get screen made of plastic, aluminum and phosphor bronze, which is non-rusting. A relatively new type of screen, called louver screen, and obtainable in aluminum, has parallel cuts about 1 in. long, about 18 per inch, and the metal between the cuts is bent at 45 deg. This arrangement shown in Fig. 36, produces shade and also tends to prevent penetration of driving rain.

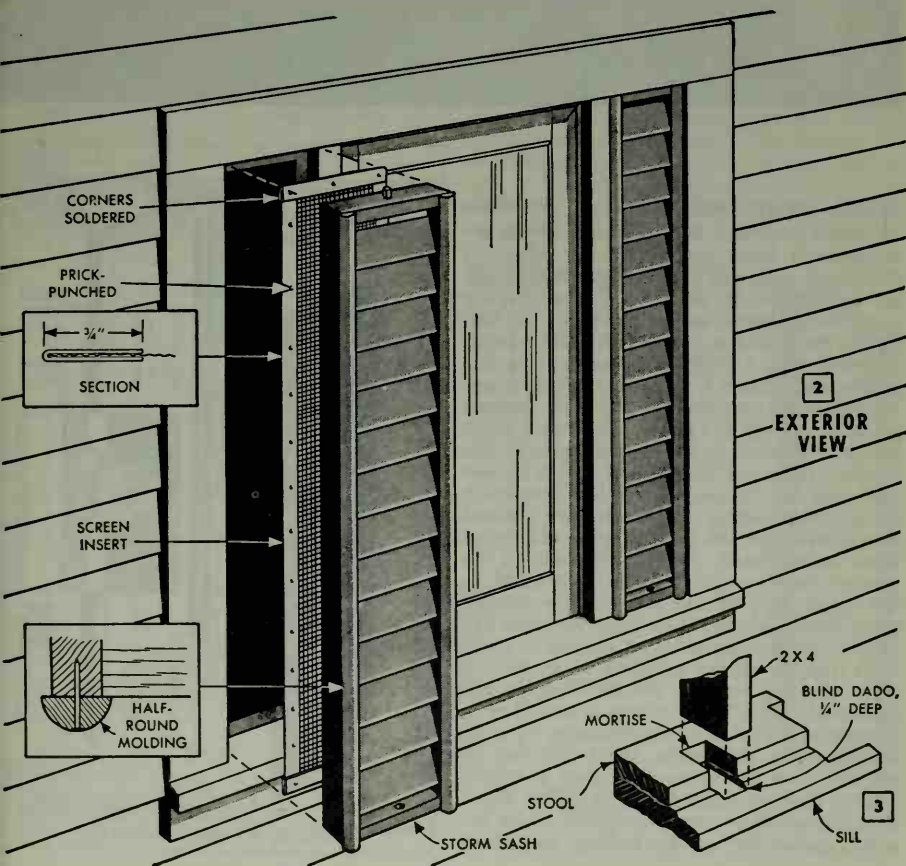
Shutters on windows: Shutters on the outside of windows are used for decoration. They can be made of wood or exterior-type plywood, and are screwed or hooked in place. On brick construction the screws are driven into lead sleeves sunk in the mortar joints.

Inside shutters, particularly the double folding kind, often are preferred to draw drapes or venetian blinds. The shutters allow air circulation while restricting visibility, and therefore are especially serviceable for bedrooms.

WINDOWS



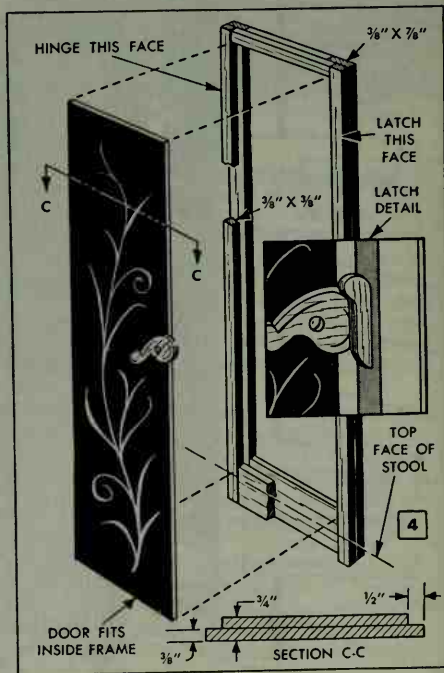
Although designed primarily for summer cottages, these windows are suitable for installation in small ranch-type homes, particularly those with board-and-batten construction. From the outside, the louvered inserts appear to be ordinary window shutters





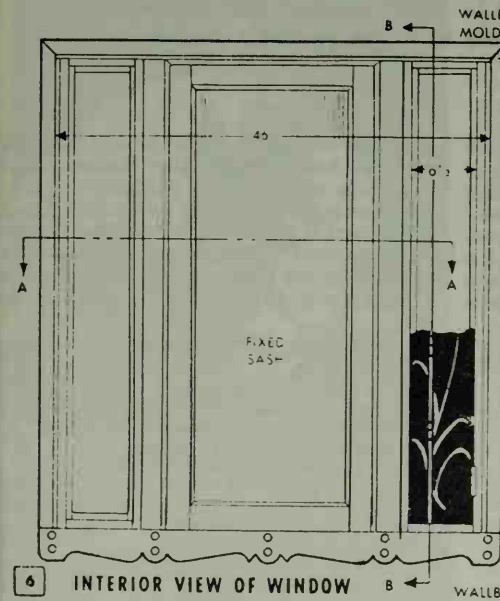
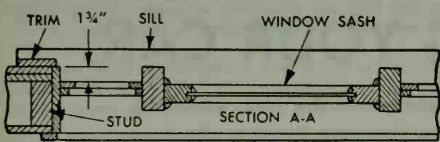
THE REMOVABLE louvers of these novel windows not only add to the architectural lines by giving the effect of shuttered sash, but they also provide ample air circulation in summer and serve the purpose of storm sash in winter. As detailed, the frame is fitted with solid, hinged shutters with a painted decoration on the inside, Figs. 1 and 4, while the openings are closed on the outside by removable louvers made as in Figs. 2, 3 and 7. The frame must be large enough to accommodate both the window sash and the louvers, which fit into openings $6\frac{1}{2}$ in. wide. Vertical members, or muntins, within the frame are dadoed into the sill and the stool is notched around them as in Fig. 3. The upper ends of the center members are simply toenailed to the upper rail of the frame. The single-pane fixed sash, Fig. 6, is fitted between the center frame members and is held in place with quarter-round molding as in section A-A. On the outside, the molding should be coped at the corners and attached with screws so that it is easily removed without damage. On the inside, the joints can be mitered and the molding nailed in place.

Note from sections A-A and B-B in Fig. 6 that the apron overlaps the stool, while the sill is nailed flat on the header, not tilted



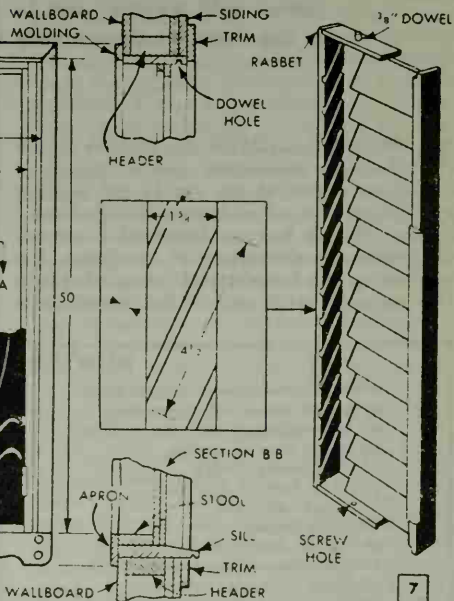


Screen inserts are made by folding strips of metal in half lengthwise and placing over edges of screen wire. Prick-punching the metal holds wire in place



at an angle. There are two ways of installing the frame: Assemble the frame first, and then fit it into the wall opening, or simply build it into the opening piece by piece. If the latter method is used, set the sill and the headpiece first. Then fit the side members and also the center members in place.

The inside panels, Figs. 1 and 4, are hinged at the outer edge and swing into built-up frames as in Fig. 4. The frames are made by nailing and gluing together strips of two different widths, making a frame rabbeted on all four inside edges. Likewise, two plywood panels are fastened together to form a matching rabbet, section C-C, Fig. 4. Tight closure of the panel is made by means of a two-part hardwood latch in scrolled design. Construction of the louvers is detailed in Fig. 7. Grooves to take the louver slats are laid out on the uprights, or stiles, as in the detail. The slats are of $\frac{1}{4}$ -in. stock and the lower edges are beveled so that they are flush with the outer edges of the stiles when assembled. After assembly of the unit, the edges of the stiles are finished with half-round molding as in Fig. 2. Note that the molding is placed so that it overhangs the edges slightly. For summer use, screens are placed behind the louvers as in Figs. 2 and 5. In winter, the space can be closed by panels made by gluing together several thicknesses of felt paper. The louver unit is installed in the frame by placing the top end so that the short dowel enters the hole drilled in the frame. The bottom end is held securely in place by a single wood screw.





WINTERIZING YOUR CAR

You won't be the fellow who's stalled at the curb when the mercury tumbles if you give your car a complete checkup before cold weather sets in. Start planning now to have a car that's as dependable in winter as it is in summer

WHEN IT COMES to smooth cold-weather operation, one of the most important parts of the car is the cooling system with its valuable new filling of antifreeze. If you have a late-model car, all that may be necessary to condition the cooling system for winter driving is to clean the radiator with one of the compounds

made for this purpose and flush it out with a garden hose. Simply allow the compound to remain in the system the length of time specified in the directions on the can. Then, disconnect the outlet hose from the bottom of the radiator and insert the garden-hose nozzle into the filler neck, flushing out the radiator with a gentle spray. Be sure to

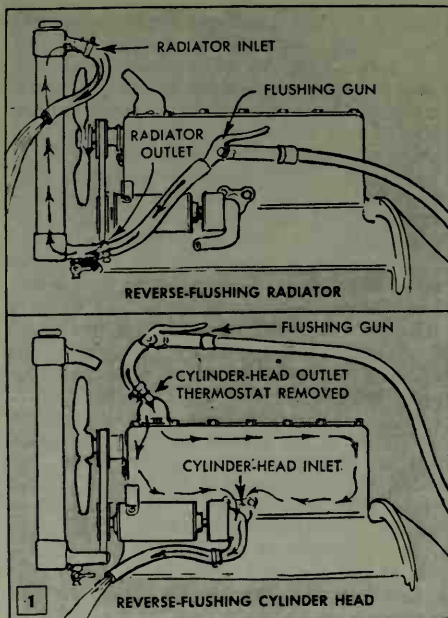
WINTER CHECK LIST

- | | |
|-------------------------------------|-------------------------------------|
| ✓ Flush radiator and cylinder block | ✓ Drain water from fuel tank |
| ✓ Inspect hoses and connections | ✓ Adjust carburetor |
| ✓ Add antifreeze and rust inhibitor | ✓ Check fuel-line connections |
| ✓ Adjust fan-belt tension | ✓ Inspect exhaust system for leaks |
| ✓ Test battery charge | ✓ Change to winter-grade lubricants |
| ✓ Clean battery terminals | ✓ Equalize brakes |
| ✓ Inspect generator | ✓ Cross-switch tires |
| ✓ Check starter motor | ✓ Lubricate hinges, locks, etc. |
| ✓ Inspect distributor | ✓ Check weather stripping |
| ✓ Clean and adjust breaker points | ✓ Touch-up rust spots |
| ✓ Check condenser operation | ✓ Inspect windshield wipers |
| ✓ Inspect and clean spark plugs | ✓ Check defroster and heater |



Radiators on newer cars can be flushed with a garden hose after cleaning compound has had time to do its work. Hose at radiator outlet is disconnected

Radiator hoses are inspected and defective ones replaced. All hose clamps should be tightened carefully to prevent possible leakage of antifreeze solution

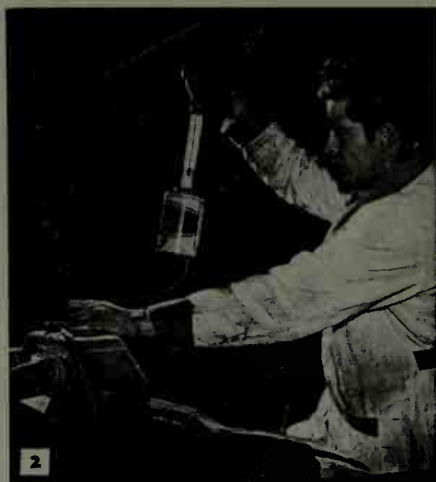


disconnect the lower hose, rather than merely open the drain cock, as the latter will not permit a sufficiently fast flow of water to carry away all the rust and scale loosened by the cleaner. For more efficient cooling-system cleaning on all cars, but especially on older models having small-core radiators, reverse-flush the radiator and cylinder-block water jacket separately, as shown in Fig. 1. These parts are flushed individually so that foreign matter from the cylinder block does not enter the radiator. If one is available, use a flushing gun which combines water and air pressure to facilitate loosening and removing rust and scale. Remember to remove the thermostat from the cylinder-head outlet before flushing the water jacket. To determine if a radiator core is clogged prior to flushing it, disconnect the radiator inlet and outlet hoses and plug the connections tightly. Fill the radiator with water, leaving off the filler cap, and then pull the plug from the bottom, or outlet, connection. If the water gushes out of the opening, the core allows a free flow of water but, if the water flows rather slowly, the core is partially clogged and must be cleaned out.

After the cooling system has been cleaned, inspect the hoses and replace defective ones. When connecting the hoses, make sure that all the clamps are sufficiently tight to prevent leakage of the antifreeze. Also check around the shaft of the water pump for indications of leakage between the shaft and the bearing. If leakage is

evident, the worn parts of the pump should be replaced immediately, as this will not only result in a loss of antifreeze but may draw air into the cooling system. The air increases the volume of the coolant so that some of it is lost through the overflow and it also accelerates the formation of rust in the system. When the cooling system is in shape, add water, antifreeze and rust inhibitor. The latter is included in some antifreeze solutions. The liquid level in the radiator should be approximately 1 in. below the bottom of the filler neck so that when the solution becomes warm and expands it will not drain out through the overflow. The freezing point of an antifreeze solution can be determined by using a hydrometer made specifically for this purpose, Fig. 2. Use the correct hydrometer for the type of antifreeze in the system and test the solution at the particular temperature for which the instrument is calibrated. Don't forget that the efficiency of the cooling system, as well as the operation of the generator, depends on the tension and condition of the fan belt. Replace a worn belt and adjust the tension by swinging the generator on its mounting so the slack in the belt is between $\frac{1}{2}$ and $\frac{3}{4}$ in.

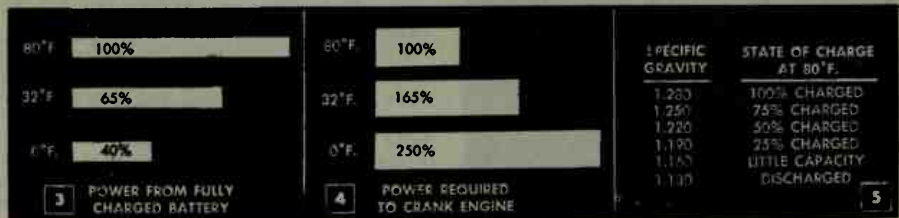
The condition of the battery is the first thing to consider when getting the electrical system in shape for winter driving. Remember that a battery is most efficient at a temperature of about 80 deg. F. and that its efficiency decreases to only 40 percent at a temperature of 0 deg. F. The chart, Fig. 3, graphically illustrates the reduction in cranking power available from a battery as the temperature decreases. Fig. 4 shows the increased power necessary to crank an engine under similar temperature conditions. By comparing these charts, you can realize the necessity for keeping the battery fully charged during the winter months. The battery charge is checked by using a hydrometer to read the specific gravity of the electrolyte solution. Note in the table, Fig. 5, that a fully charged battery cell has a specific gravity of 1.280 at 80 deg. F. However, if you take a hydrometer reading under extreme temperature conditions, be sure to correct it accordingly. Add 4 points (.004) to the reading on the scale for each 10 deg. the tempera-



With a hydrometer made especially for the purpose, check to make sure that the freezing point of the antifreeze solution in the radiator is sufficiently low

ture of the electrolyte is above 80 deg. F. and subtract .004 for each 10 deg. below 80 deg. Allow a battery that has been rapidly discharged to stand for a while before taking a reading. In this way, the reading will be more accurate, as the solution will have had time to remix. Before checking the battery, be sure that the hydrometer is clean and in good condition. If the paper scale inside the float is wet, the float leaks and the hydrometer will not give an accurate reading. When taking the reading, hold the hydrometer vertically and at eye level. Keep the battery terminals clean and the connections tight and recharge or replace the battery as necessary. The distilled-water level should always be about $\frac{3}{8}$ in. above the top of the battery plates.

A frequent cause of hard starting is dirty or wet spark plugs, wires or distributor cap which permit the current to leak away. See that these units are kept dry and clean and also clean the distributor breaker points. At the same time, check the points for pitting and proper spacing. If they are burned and pitted, they should be replaced, as well as the condenser which is the probable cause of this trouble. The specified





Above, set breaker-point gap by loosening screw on plate and adjusting eccentric. Below, notice dirt accumulation on outside of carburetor air cleaner



Below, solution can be added to gasoline to absorb water condensation and prevent freezing in fuel line

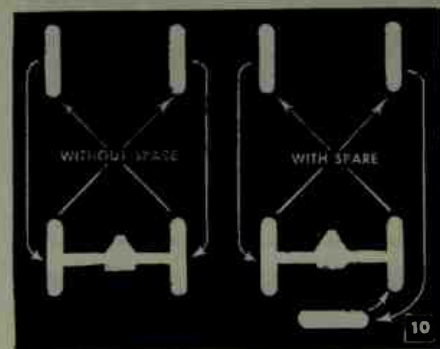
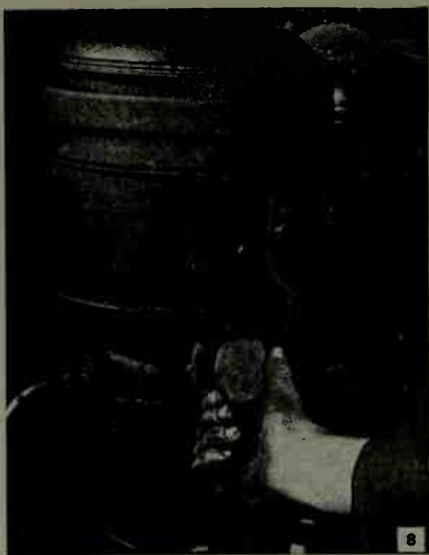


breaker-point gap will range between .018 and .022 in., depending on the make of car, and it should be set carefully according to the manufacturer's instructions. The gap is checked with a thickness gauge and set by loosening the screw which locks the breaker-point plate and adjusting the eccentric screw, Fig. 6. Check the wires in the distributor for breaks and frayed portions. Examine the top of the distributor cap for cracks and be sure that the spark-plug cables and the center cable from the coil make good contact in the socket terminals. Also inspect the rain guards over the cables to see that they fit tightly and are not cracked. These prevent moisture from entering the distributor and, therefore, are important to good winter performance.

To check the operation of the ignition, disconnect the coil cable at the distributor. Then, while cranking the engine, hold the cable $\frac{1}{4}$ in. from the cylinder-head block. If the spark jumps this gap, the ignition coil and its circuit are in good condition. Clean the spark plugs and space the electrodes by bending the side electrode to obtain the gap recommended by the manufacturer. This ordinarily will be from .025 to .029 in. Clean the electrodes with fine sandpaper and inspect the plug gaskets, replacing any that may be scored. When removing or installing the spark plugs, always use a socket wrench of the correct size to avoid damaging the porcelain. To replace the plugs, turn them into the cylinder head by hand as tightly as possible, and then tighten them one half to three quarters turn with the wrench. Be careful not to make them too tight.

Clean and tighten the generator connections, especially at the cutout, and inspect the brushes. Also see that the contact points on the voltage regulator are clean. Do not overoil the generator. A drop or two of oil on the bearings every thousand miles is sufficient, as too much lubricant coats the commutator with a film which results in arcing and pitting. This film can be removed from the commutator by merely touching the surface with 6/0 sandpaper while the generator is running.

The starter motor must be in good condition for winter driving. If necessary, clean the commutator with sandpaper and replace and align the brushes. Brushes worn to half their original size should be renewed, and they must be replaced parallel with the commutator segments. Polished spots on the armature core or field pieces indicate worn shaft bushings which cause the armature to rub against the field poles. In this case, new bushings should be installed. The starter motor, as well as the generator, is likely to be damaged by excessive oiling. A small amount of light cup grease applied to the bearings, unless they are the self-oiling



type, will furnish satisfactory lubrication.

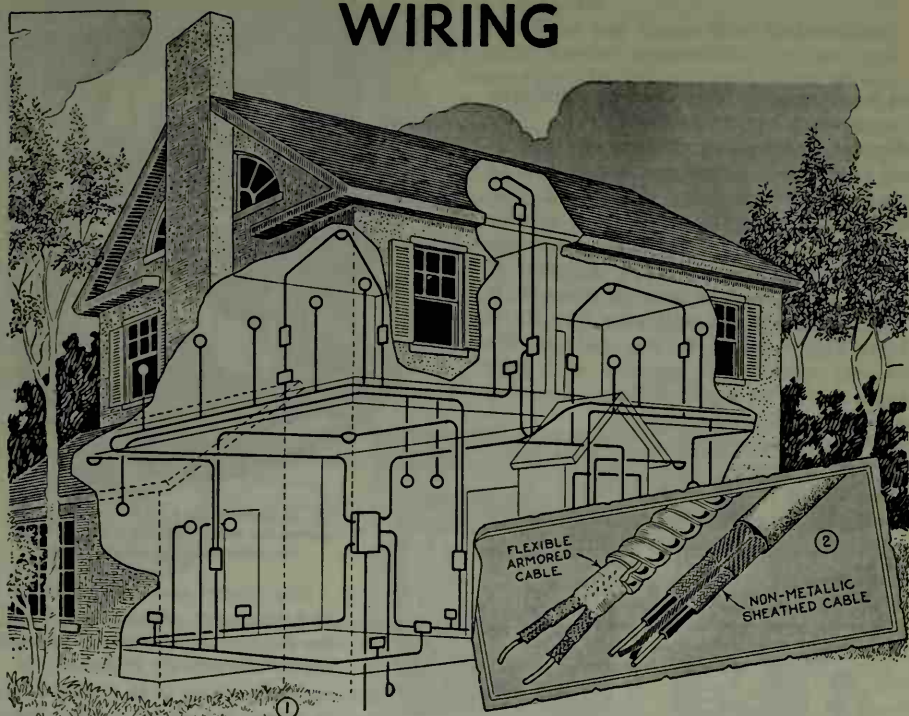
Carefully check the fuel system to see that it is functioning properly. All the fittings and lines on both the suction and pressure sides of the fuel pump must be tight and in good condition. The carburetor-float level should be set high enough to provide a richer mixture for winter. The automatic choke also is likely to have a winter setting to provide a richer starting mixture. The choke is adjusted by turning the thermostat control slightly, as shown in Fig. 8. Take a look at the carburetor air cleaner. If the outside of the unit is dirty, as indicated by the arrows in Fig. 7, you can be quite sure that the cleaner is no longer operating efficiently and should be removed for a thorough cleaning. Another way to check the cleaner efficiency is to remove it while the engine is running. If the engine speeds up considerably, the cleaner is either dirty or damaged. Should the air cleaner not be dirty after a few thousand miles of service, chances are that it is not working properly because of internal failure or by-passing of the air through a leak in the connection between the cleaner and the carburetor. Drain the fuel tank to remove any water and sediment and, if desired, add a special solution to the gasoline to absorb water condensation. This will prevent accumulated water from freezing in the fuel lines. The crankcase should be drained and flushed to remove sludge and other foreign matter which may clog the oil-filter screen and also cause sticky rings and valves. The crankcase oil should, of course, be changed

to one of the recommended winter grades.

As even braking is essential for safe driving on slippery pavement, see that the brakes are properly adjusted. Better traction and braking surface can be obtained by cross-switching the tires as shown in Fig. 10. To get maximum wear from your tires, it is a good idea to do this every 3000 to 5000 miles regardless of the season. Check the operation of the heater and defrosters. If you have a hot-water heater, you can increase its efficiency by flushing it out when you are flushing the radiator and cylinder head. Finally, make sure that the windshield wipers will give dependable service during the winter months. On wipers equipped with a water-spray attachment, fill the container with a solution of glycerin, 1 part, and water, 2 parts, as pictured in Fig. 9. This will aid in preventing ice formation on the windshield.

(Certain information and diagrams courtesy Plymouth Motor Corp.)

WIRING



WHEN wiring old houses or adding new convenience outlets in houses already wired, it is first of all a job of careful planning to determine all the requirements including the location of the outlets, materials to use, wire size, load distribution and other factors. Then, it is just as important to do the work entirely in accordance with approved wiring practice to meet electrical and safety requirements.

Materials: For wiring an old house, the most convenient materials to use are armored cable, commonly known as B-X, and non-metallic sheathed cable, Fig. 2. General installation methods are the same for both. Knob-and-tube and conduit installations are more difficult in finished buildings and will not be considered as they occasion considerable damage to walls and floors. Also, knob-and-tube work is not permitted in many localities.

Code Requirements: The National Electrical Code, published by the National

Planning the Installation and Arranging for Service Connections

Board of Fire Underwriters, gives minimum requirements for safe electrical installations. All recommendations contained in these ar-

ticles are in accord with the national code. However, some localities have additional restrictions and one should find out about these before undertaking a wiring job.

Types of Service: Service supplied by the power company may be alternating or direct current, usually the former at between 110 and 120 volts. Before making any plans, find out what type of service is to be used. In the case of both a.c. and d.c. there are two types of service commonly furnished; two-wire and three-wire. Fig. 3 shows the difference. Most power companies supply three-wire service, except for very small installations. The power company will install lines up to the house. From that point on the service connections (lines to the fuse boxes, including switches, meter, etc.,) are usually installed at the expense of the owner. The power company

lays down specifications as to type and size of equipment and its location.

Service Connections: The easiest, and in most cases the required, method will be to inclose the wires from the power line inside rigid conduit, which is a special smooth pipe designed for holding electric wires. It must be galvanized. Conduit of the 1-in. size should be used for three No. 8 wires; $\frac{3}{4}$ -in. conduit will take two No. 8 wires. The conduit is run outside the building, where it is secured with pipe straps. A service cap of the type shown is installed at the top to keep out water. The conduit is bent into a curve of large radius where it enters the building as shown in Fig. 4.

PORCELAIN INSULATORS
POWER CO. INSTALLS LINES AND MAKES CONNECTIONS

SERVICE ENTRANCE CAP
110-VOLTS
110-VOLT LAMP

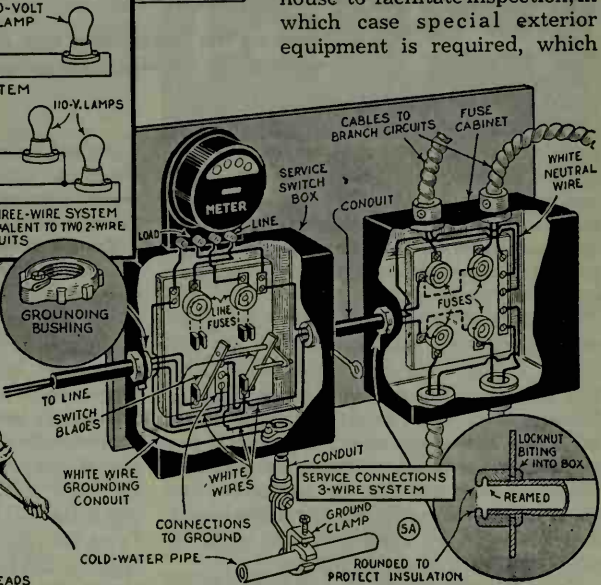
(A) TWO-WIRE SYSTEM
110-V. BRANCH CIRCUIT
110-V. LAMPS
P20 VOLTS
NEUTRAL OR GROUND-ED WIRE
110-VOLTS
110-VOLTS
(B) 110-V. BR. CIRCUIT
THREE-WIRE SYSTEM EQUIVALENT TO TWO 2-WIRE CIRCUITS

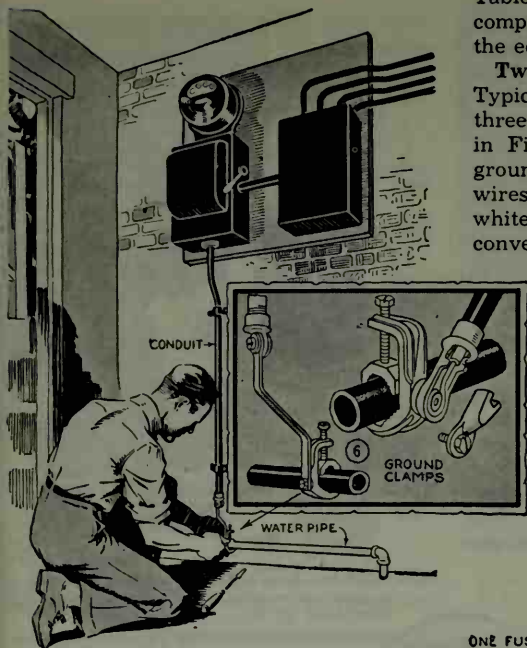
NOT LESS THAN 10 FT. ABOVE GROUND
WIRES PULLED THROUGH AFTER CONDUIT IS INSTALLED
PIPE STRAP
1ST FLOOR
RADIUS OF CURVE NOT LESS THAN 6 TIMES DIAMETER OF CONDUIT
INSTALLING SERVICE LEADS



All convenience outlets should be spaced the same distance from the floor for uniformity of appearance

The meter and main switch and fuses are often located in the basement, as close as possible to the service entrance. In some localities it is customary to install the meter outside the house to facilitate inspection, in which case special exterior equipment is required, which





Effective grounding is accomplished by connecting a conduit from the switch box to a cold-water pipe by means of a special clamp

can be determined by consulting with the power company. For a basement installation, a board is nailed to the wall for mounting these units. The end of the conduit is cut off and threaded, leaving about $\frac{3}{8}$ in. to extend inside the switch box. After the conduit has been cut, it should be carefully reamed to remove all burrs. One of the numerous round depressions called "knockouts" is removed by a sharp blow with a screwdriver or hammer, and the hole is reamed. An approved safety-switch of the general type shown in Fig. 5 must be used. A locknut is put on the end of the conduit, the box is put in place, and a bushing is screwed onto the end of the conduit, as shown in a detail of Fig. 5A. The locknut is then tightened.

The wires are fished through the conduit by passing a light wire through the conduit, attaching the wires to it, and pulling them through. Usually, for average-size homes, the wires for service connections should be No. 8 rubber-and-cloth covered. One white and one or two black wires should be used. This size wire will carry a maximum load of 30 amperes. For larger loads, larger feeders are required. See

Table I. As pointed out before, the power company will generally specify this part of the equipment.

Two-Wire and Three-Wire Connections: Typical service connections for two and three-wire 110-volt a.c. or d.c. are shown in Figs. 5A and 7. The connections to ground, and the use of white and black wires should be noted in particular. The white wire always should be grounded for convenience in tracing. Grounding of all electric conduits and boxes is a matter of safety as it automatically causes a fuse to blow if a live wire accidentally touches exposed metal parts, thus preventing dangerous shock and possible fires. For

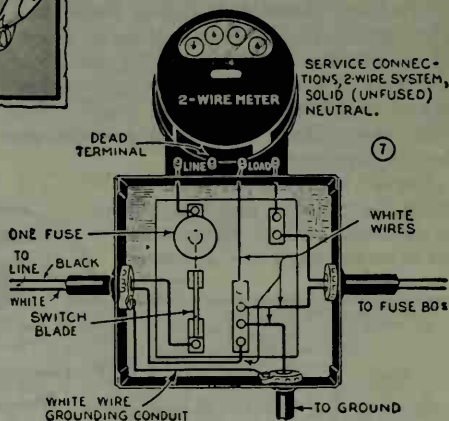


TABLE I—SERVICE CONNECTIONS

Wire Size	Fuse Size, Amperes	Max. Load (Watts at 115 V.)	Minimum (inches)	Conduit Size 3-wire	2-wire	1-wire*
8 Type R	40	4600	$\frac{3}{4}$	$\frac{3}{4}$	$\frac{1}{2}$	$\frac{1}{2}$
8 Type RH	45	5175	$\frac{3}{4}$	$\frac{3}{4}$	$\frac{1}{2}$	$\frac{1}{2}$
6 Type R	55	6325	1	1	$\frac{1}{2}$	$\frac{1}{2}$
6 Type RH	65	7475	1	1	$\frac{1}{2}$	$\frac{1}{2}$
4 Type R	70	8050	1**	1**	$\frac{1}{2}$	$\frac{1}{2}$
4 Type RH	85	9775	1**	1**	$\frac{1}{2}$	$\frac{1}{2}$

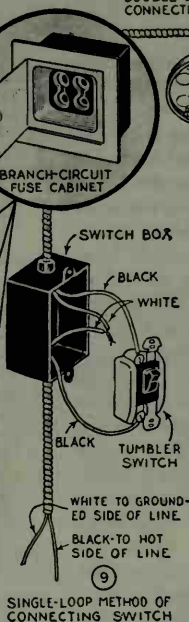
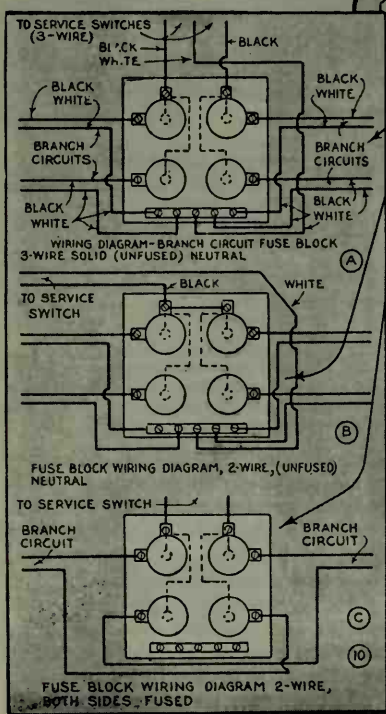
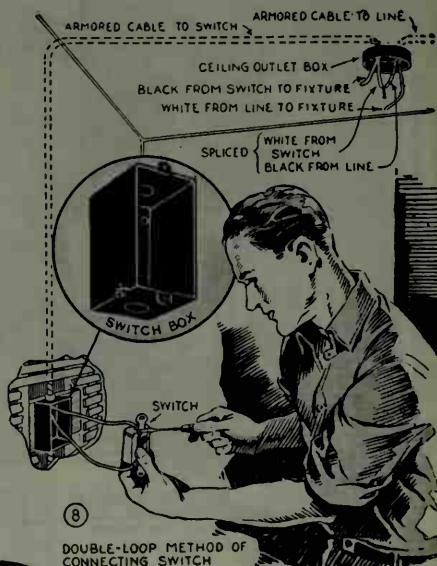
* For grounding wire only, when required.

** If a service run exceeds 50 feet and includes more than the equivalent of two quarter bends, $1\frac{1}{4}$ -inch conduit must be used.

grounding, a conduit is run from the switch box to a water pipe and clamped to the pipe with a ground clamp of the type shown in Fig. 6. A single No. 8 white wire is run inside this pipe and securely fastened to the terminal provided at the pipe. A No. 8 copper wire should be fastened to this conduit and the power-line conduit. The grounding bushing, detail of 5A, makes this easy. The wire inside the ground conduit is attached to the proper terminal.

Fuses and Meter Connections: The main-line fuses should be installed in the box with the service switch. For most homes 30-amp. fuses are required. The connections to the meter are usually made by the power company. A short length of conduit can be run from the line-switch box to the fuse cabinet, and the wires can be pulled through readily. Bushings and locknuts must be used. The fuse box or cabinet contains one fuse for each branch circuit. The neutral or grounded wire is continuous or unfused at all points. However, some localities require fusing the neutral wire also. The "hot" wires (black wires) are fused in all cases as shown. When a fuse blows, the reason should be located and eliminated. A fuse block for a four-branch-circuit installation is shown in the circular insert above Fig. 10, while methods of wiring are shown in details A, B and C of Fig. 10. It is wise to get a fuse box larger than needed, to provide for future expansion.

Survey of Needs: Next determine the number and location of electrical outlets. By an outlet is meant any point at which



The double-loop and single-loop methods of connecting wall switches to outlets are shown in Figs. 8 and 9

electricity can be drawn from the line. This includes lighting fixtures, heating devices and machines that are permanently attached to the line, and convenience outlets for attaching portable lamps and apparatus. Switches are not counted as outlets. It is best to be rather liberal in planning outlets. There is no reason for omitting lights in any room, even closets. All ceiling lamps should be controlled by wall switches. Lights on stairways should be controlled by switches at top and bottom. Convenience outlets should be spaced about one every 10 ft. of wall space (counting doors and windows), in living rooms, and usually 15 to 20 ft. in bedrooms and dining room. It is best to locate them where particularly needed. Generally they are placed just above the baseboard. At least

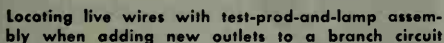


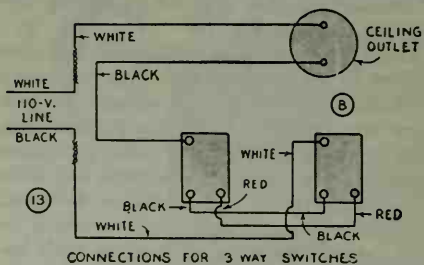
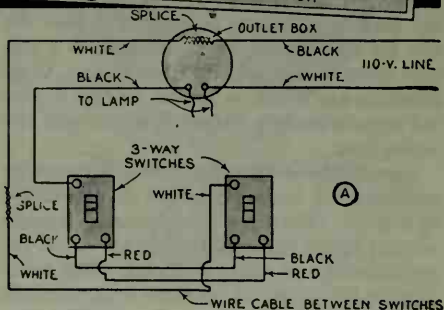
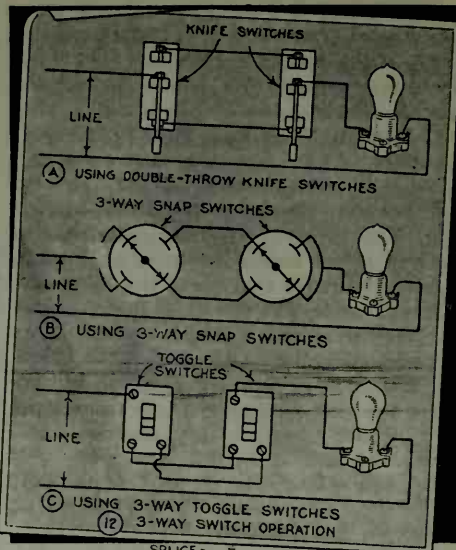
TABLE II—WIRE SIZE FOR BRANCH CIRCUITS

Wire Size	Max. Safe Load Watts—115 V.	Use Fuse Size Amps.
14	1725	15
12	2300	20
10	3450	30
6	5750	50

two outlets should be provided in the kitchen and outlets in the basement should be located to care for washing machine, iron, mangle and workshop.

Branch Circuits: Each branch circuit usually feeds a number of outlets. In most homes all branch circuits are wired with No. 14 wire. The load on each branch circuit is therefore limited by the carrying capacity of this size wire, or to 15 amperes. In planning branch circuits, therefore, it is wise to limit the possible demand to a value below 15 amps. As most electrical appliances are rated according to power consumption in watts, and volts times amperes equal watts, the maximum safe load for No. 14 wires is 115 times 15, or 1725 watts. Generally circuits are designed for an estimated load of 1200 watts at most, as required in many cities. Frequently it is also required that no branch circuit include more than twelve outlets.

Generally it has been found that independent circuits should be used for the following devices or groups of devices: Oil



burners; laundry lights and outlet for washing machine or mangle; workshop lights and outlets for power-driven tools; refrigerator; any heating appliance drawing more than 1000 watts; any apparatus with larger than ¼-hp. motor. Should any appliance draw more than 1500 watts, larger wire as specified in Table II will be required for its circuit.

In three-wire systems it is quite important that the load be balanced or evenly distributed between the two legs of the

circuit. There is a complete 110-volt circuit between each hot wire (black wire) and the grounded wire (white wire) of a three-wire system. The loads on these two legs should be approximately equal.

Connecting Wall Switches: There are two methods of connecting wall switches. In the double-loop method, Fig. 8, the hot and grounded wires are led into the outlet box. A cable is run from the outlet box to the wall switch and is connected as shown. Note particularly the use of the different colors of wire. The hot wire to the outlet box is black as usual. This is connected to the white wire leading to the switch. The black wire from the switch, which is hot when the switch is closed, and the white or grounded wire are then connected to the fixture.

The single loop is an alternative method which can be used where the double loop would be inconvenient. For example, if the lead to a fixture passes right past the site for the switch; or if the lead to a fixture must be brought up from below. Connections are made as shown in Fig. 9. The hot wire is broken before it comes into the outlet box.

Use of Three-Way Switches: Three-way switches are installed to act as illustrated in Fig. 12. They are always used in pairs so that lights may be turned on or off independently at two locations. The color scheme for single and double loop methods of connecting this type of switching circuit is shown in Fig. 13.

Locating Live Leads: When adding new outlets to a branch circuit, it is necessary to locate live wires into which the new lines can be tapped. To accomplish this, first open the switch at the meter, and then open an outlet box that you think will offer the desired leads. The tape is removed and the wires are separated carefully so that there is space of at least an inch between them and no chance of their touching each other. Then the main switch is closed and all other switches turned off. Each pair of wires is now touched with the prods of a test lamp, as in Fig. 11. If the lamp lights, the two wires it is touching are permanently hot and will serve as a starting point for the new connections.

Location of Hidden Outlet Boxes Determined by Using Compass



Electrical outlet boxes for wall plugs often become "lost" when covered by mistake during plastering. To locate the buried-box, use a magnetic compass instead of marring the wall by tapping and exploratory digging. Hold the compass in the normal, horizontal position and slide it up and down the wall. When near any large piece of metal, such as an outlet box, a marked deflection of the needle will occur.

Locating a Short Circuit in Home Appliances

When electric fuses repeatedly blow out in the home and you suspect a short circuit in one of your lamps or appliances, try this test to locate the trouble. Turn off all wall and ceiling lights and pull the plugs of all lamps and appliances. Then, screw a 100-watt light bulb into the socket where the fuses have blown. If the bulb lights immediately, it indicates a short somewhere in the house wiring, in which case the main switch should be thrown and an electrician called at once. However, if the bulb does not light, plug in the lamps and appliances one by one and watch the effect on the bulb. If, when a lamp is plugged in and turned on, the test bulb lights to its full brilliancy but the lamp bulb does not light at all, the short is in that lamp. If no short is present, both bulbs will light at half brilliancy. Only heavy-wattage heating units and motorized units free of shorts will become warm when subjected to this test, although the test bulb may light to full brilliancy.

WIRING

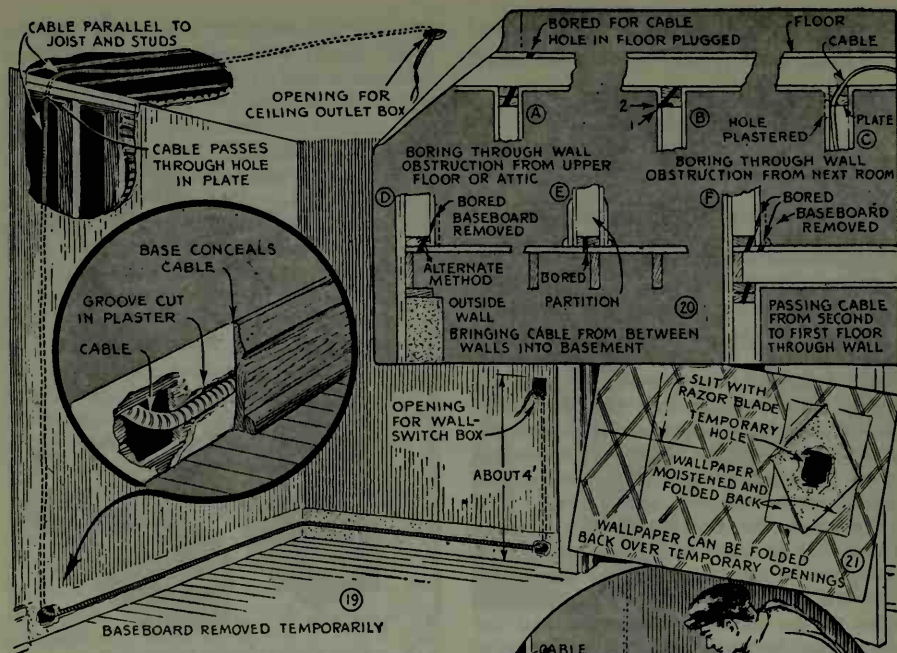
Installing the Equipment

ALTHOUGH the switch and outlet boxes are not installed until after the cables have been pulled through partitions and floors, it will be necessary to locate the exact position of the switch and outlet boxes first, and then to make the wall and ceiling openings. In this way the cables can be pulled from one opening to the next, and the ends of the cable left extending from the openings for later testing and subsequent attachment of the boxes.

Openings for Outlet Boxes: Switch boxes may be used singly or a number of them can be combined side by side which is called "ganging." In the latter case the sides of the boxes are removed and the remaining portions attached together to form a single large box. Whether the wall opening is to accommodate one switch box or a number of them, the procedure of cutting an opening just large enough, and no larger, is the same. First locate the approximate position between two studs, carefully drill a hole in the wall and remove just enough plaster to find the opening between laths. Then, mark the outline of the box on the wall with a pencil so that one lath will cross the center. Then, with a hacksaw blade, carefully cut out a section of this lath along the pencil marks and saw into the adjacent ones just enough to form a hole to take the box, Fig. 14, so that the small tabs at the top and bottom of the box can be screwed to the uncut portions of lath. The hacksaw blade should be used so that it cuts on the pull stroke.

To install a ceiling outlet box, the most common types of which are shown in Fig. 16, use a bar hanger of the type shown in Fig. 17. A wire is fastened to the movable stud and the bar is pushed through a hole in the ceiling, after which the wire is used to pull the stud back to project through the opening. The hanger is turned so that the bar lies across the lath, which will distribute the load. The outlet box is to be attached to this stud as in Fig. 16. The box may or may not be countersunk in the





plaster, as shown, depending on the size of the fixture canopy.

Installing Cable: It is easy to pass a cable from point to point when there is a clear space between joists or studs extending all the way from one outlet to the next. Another simple job is to install a wall outlet on the first floor, as you can usually drop the cable down into the basement where it is connected to the nearest outlet box. But where the cable must cross studs as in Fig. 19, you can either drop it into the basement or you can run the cable behind the baseboard, removing plaster to form a groove for the cable. To drop the cable into the basement you will have to pass it through the partition plate. Two methods of doing this are shown in details D and E of Fig. 20. To pass the cable through partition plates at the ceiling as in Fig. 19, it may be possible to drill this hole from above, as in detail A of Fig. 20. The hole can be plugged later. Otherwise the method shown in details B and C, Fig. 20, can be followed. To do this, first slit the wallpaper as in Fig. 21, fold the paper back and make a hole large enough so that you can insert the bore at an angle to go through the plate. Then drill a second hole straight

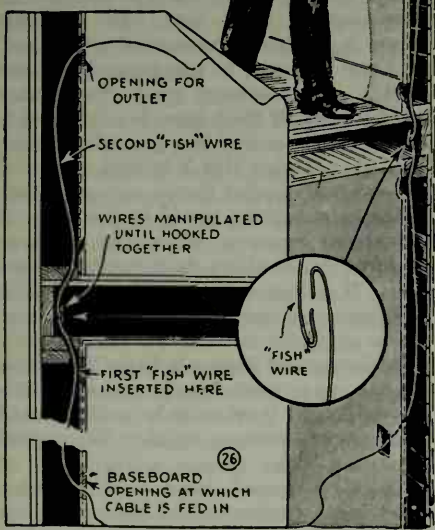
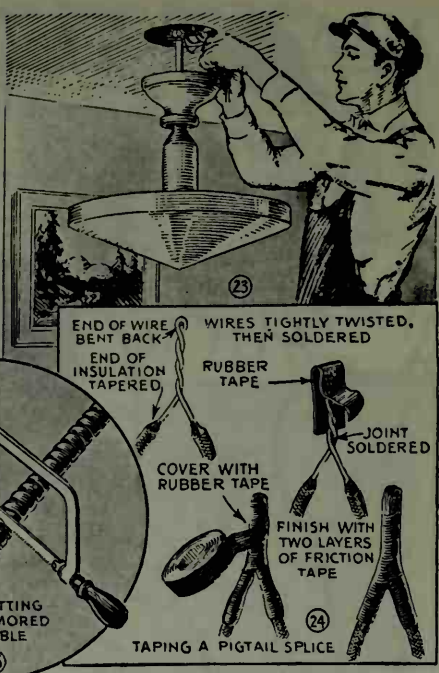


across at the bottom but only partly through the sill, after which the cable can be passed through the plate easily as in detail C of Fig. 20.

When passing a wire from one floor to another, it may be necessary to go through a sill and plate as in detail F of Fig. 20. When encountering other forms of obstructions, it is sometimes possible to run the cable exposed through attics, and in closets where exposed cable is not objectionable. For example, Fig. 22 shows a cable run around the obstruction that was drilled through in detail F of Fig. 20. In some cases the baseboard can be removed

and the cable can be hidden behind it where it comes up through the floor, making it even less noticeable.

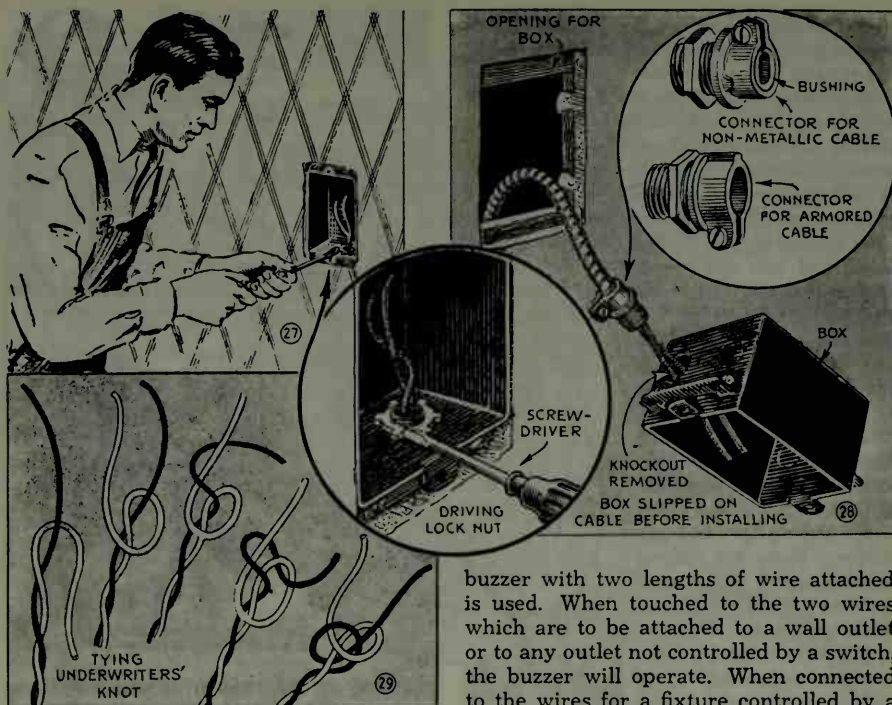
In pulling cables from point to point, you will find a "fish wire" handy. This is first passed through the channel and then the attached cable is pulled through. Any fairly stiff wire will be suitable. In some cases it is necessary to use two lengths of fish wire as in Fig. 26. In this case one length is pushed into the opening at the ceiling and pulled out at the baseboard opening. A hook is formed on the end of this wire and pushed up through the hole in the sill. A hook is also formed on the end of the second wire, which is pushed down from the top. The two wires must be hooked together, which may require some effort and patience. Then by pulling at the upper outlet and guiding the wire at the other openings, it is possible to pull the hooked joint out at the top, which leaves a continuous length of wire between outlets. Besides



the use of fish wires, ordinary furnace chain is useful for pulling up wires through partitions. It is dropped down from an upper opening and the lower end is pulled through sill holes by means of short wire hooks, after which the wires of the cable are attached and the cable is pulled up.

A length of cable long enough to reach from one outlet to the other, with a couple of feet surplus, is cut next. The manner of cutting B-X is shown in Fig. 25. Non-metallic cable is cut with a sharp knife. The wires are cut with a pair of side-cutting pliers. The end of the cable is fastened securely to the end of the fish wire and it is then fed in at one opening while the wire is pulled at the other opening and guided at temporary openings between the two. The entire cable is pulled in leaving only about 8 or 10 in. for connections at the outlets.

Connecting Cable to Boxes: After all cables have been located and their ends project from the holes, the switch and outlet boxes are installed. Each box has a number of "knock-outs" and the required number of these must be removed by striking them with a ball-peen hammer.



Then the cable covering is removed about 8 in. from the end. Do this carefully to avoid damage to the wires which are left extending. Now fit a connector to the cable and attach to the box as in Fig. 28, driving the locking nut home with a screwdriver as in Fig. 27. Before a switch box is screwed to the lath, the tabs on the top and bottom are adjusted so that when fastened in place, the front edges of the box will be flush with the surface of the wall.

Splices: As all connections are made within outlet boxes, there will be no great strain on splices, except in the case of drop lights. For all connections but drop lights, use the pigtail splice shown in Fig. 24, although this can be used also for drop lights if strain on the splice is relieved by tying an underwriters' knot in the drop cord, Fig. 29. The knot rests on the bushing of the outlet-box cover and takes the strain.

Testing: Before soldering splices, and before attaching fixtures, switches, or wall outlets, the circuits must be tested. With the main switch off, connect two or three dry cells in series to the new circuit. A

buzzer with two lengths of wire attached is used. When touched to the two wires which are to be attached to a wall outlet or to any outlet not controlled by a switch, the buzzer will operate. When connected to the wires for a fixture controlled by a wall switch the buzzer should not work unless the two wires for the switch are touched together. If three-way switches are used, all three of the wires should be joined together at each switch. Test three-way switches also with separate wires. If one lead is connected to the "hot" wire and the other to any grounded object (water pipe, radiator, etc.), the buzzer should work. If the buzzer is connected to a grounded wire and to a grounded object, it should not buzz. If B-X is used, the metal tube and all outlet boxes are grounded, and they should be tested in this way. If the buzzer operates when it is not supposed to, it indicates a short circuit at some point. If it does not work when it should, it indicates an open circuit (a broken conductor or faulty connection).

Soldering and Taping Splices: All splices must be made mechanically and electrically sound, and they must be soldered and insulated in a manner equal to the original insulation. The copper wires must be scraped or sanded clean before joining. After testing, rosin or non-corrosive paste soldering flux—not acid flux—is applied

and the wire is heated with a blowtorch or a hot soldering copper. Then wire solder, either plain or rosin-cored, is applied to the hot joint. If properly performed, this operation will give a perfectly tight and secure joint that will not loosen. The soldered joint is next wrapped with rubber tape as shown in Fig. 24. First fold a short length over the tail of the splices. Then wrap the splice spirally with rubber tape, starting from the insulation on one wire and overlapping the turns, completely covering the bare wire with rubber as thick as the original insulation. Finally wrap the whole splice with friction tape in the same manner, applying two layers to complete the splice.

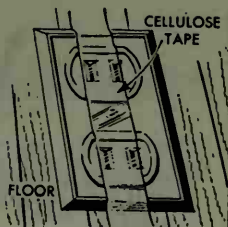
Attaching Fixtures: Switches, wall outlets and fixtures are attached next. If the screws for attaching the wires to the device are of different colors, the silver colored one is to be attached to the white wire and the brass colored one to the black wire. In the case of lighting fixtures which come wired with lampcord, one of the wires will probably have a tracer thread of a distinct color woven into the insulation. This is to be connected to the white or grounded wire in the outlet box. Large ceiling fixtures generally employ a "hickey" which attaches to the stud in the outlet box and also to the stem of the fixture. See Figs. 18 and 23. A canopy sliding up and over the stem conceals all connections. Small fixtures may be fastened as shown in Fig. 17, by means of a strap screwed to the box or to the stud, and to which the fixture itself is screwed.

Finishing: To finish the job, flush plates are installed over all wall outlets and switches. Bakelite plates in a variety of colors are generally used, although mirror or metal parts are also available. All temporary openings should be plastered over with patching plaster, which is available at any hardware store.

Baseboards and molding that were removed should be nailed to the studs, not to the lath. Holes in the floor should be plugged. A plug of the same kind of wood should be used as a rule, but in an inaccessible place, a cork held in place with hellac is often satisfactory. Finally, wall paper that has been removed should be pasted back and any place where paint has been damaged should be touched up.

Tape Protects Floor Outlet

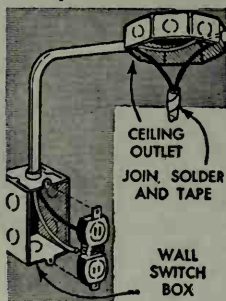
A strip of cellulose tape applied over the openings of an electric outlet in the floor of a room that is being remodeled will keep dust and bits of debris from getting into the plug. Leave the tape on until the work is finished and the dirt removed from the surrounding area.



Cutting Holes for Outlet Boxes Without Cracking Plaster

When cutting a hole in a lath-and-plaster wall for an electrical outlet box or switch, the lath frequently has a tendency to break away from the plaster and to cause it to crack or to become loosened. One electrician avoids this by marking out the area to be cut away and driving a wood screw into a lath at the approximate center of the hole to be cut. Then, pulling on the screw with his free hand in order to hold the lath securely against the plaster, he cuts the hole with a hacksaw blade. The blade is held so that the teeth make the cut on the pulling stroke.

Unused Ceiling-Fixture Circuit Adapted for Wall Receptacle



When the ceiling fixture has been removed from a living room, the unused wall switch usually is left intact. If this is the case in your home, you'll find it a simple matter to replace the switch with a convenient outlet. First, remove the decorative cover from the ceiling-outlet box and join, solder and tape together the ends of the two live wires inside the box. Then, disconnect the wall switch and wire a duplex receptacle in its place. This extra outlet will come in handy for a night light and numerous electrical appliances.

WOOD BITS

*All about
wood-boring bits—
how they work—
how to select the
right bit for the job—
how to sharpen—
etc.*

IF YOU pick up a wood-boring bit and examine it closely you will see that the head of the bit consists of a number of parts as shown in Fig. 1. Each of these does its own job when the tool is in use. The screw enters the wood first; then the spurs follow and finally the cutters. As soon as the latter strike the wood, the strain of cutting is thrown on the screw. In addition to this, the screw bears the lateral strains set up by the spurs when passing through irregularities of the grain. There is both pull and severe side thrust taken solely by the screw when the bit is passing through the wood. The spurs, it will be seen, function both as guides and cutters and determine the exact diameter of the hole. The leading edge of each spur scores the wood deeply, severing the fibers and forming a V-shaped groove, the outer side of which is vertical. The cutters merely lift the chip into the throat, from which it is carried upward by the flutes. Here is really a double-wedging action with force exerted in opposite directions. The wedging



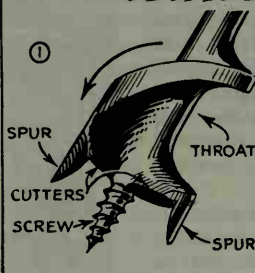
THE SCREW
PULLS THE
BIT INTO
THE WOOD



THE SPUR
SCORES THE
WOOD AHEAD
OF THE
CUTTER



THE CUTTERS
LIFT THE
CHIPS AND
START THEM
UPWARD



action of the cutters in lifting the chip tends to draw the bit into the wood, but the same action of the spurs tends to force it out. The pull of the screw must overcome any irregularity and continue to carry the bit forward at uniform speed.

An assortment of the various types of wood-boring or auger bits, as they are sometimes called, is shown in Fig. 3. You will note that they vary considerably. Take the first three, for example. The body of the first is simply a twisted hollow spiral, the head usually being made with a single cutter and a coarse or "fast" screw. Such a bit is used for rough, heavy work where speed is essential. It is particularly effective in green or wet wood. The fluted and solid-center bits are designed for fine work where holes must be bored smooth and to exact diameters. Both types of bits are usually furnished with either a medium or "slow" screw, Fig. 4, and have



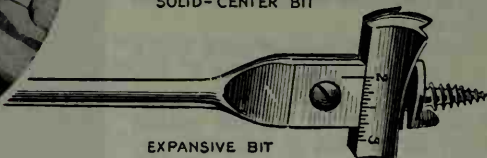
HOLLOW-SPIRAL AUGER BIT



FLUTED BIT



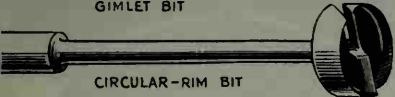
SOLID-CENTER BIT



EXPANSIVE BIT



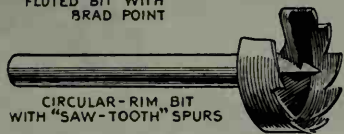
GIMLET BIT



CIRCULAR-RIM BIT

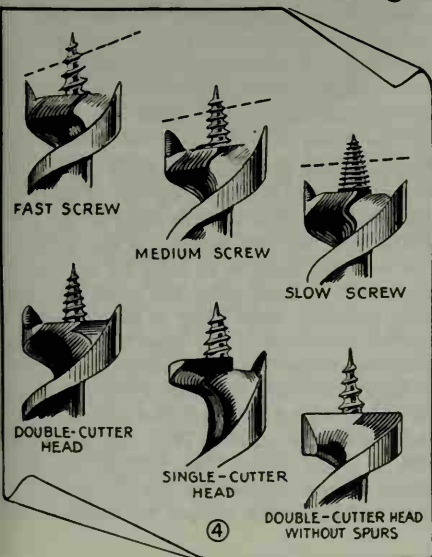


FLUTED BIT WITH
BRAD POINT

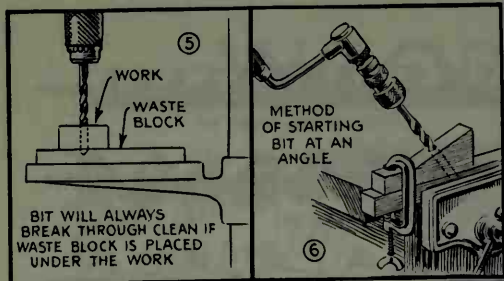


CIRCULAR-RIM BIT
WITH "SAW-TOOTH" SPURS

③

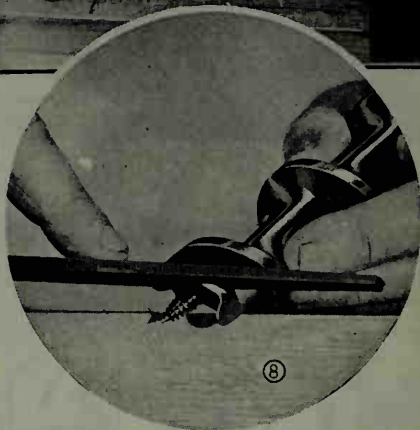


two spurs and cutters. The characteristics of the expansive bit differ from the others in that there are no flutes along the body, and one cutter and spur are adjustable in a transverse direction so that the bit can be made to bore holes of varying diameters. The expansive bit and the gimlet bit are handy to have, even in the household tool kit, the gimlet being especially useful for boring holes in either hard or soft wood. Two of the remaining three styles shown are designed exclusively for use in a drill press, although any one of them will operate satisfactorily when turned with a brace. Two types of circular rim bits are shown, the first having what is really two continuous spurs, each extending from the cutter around the circumference to the chip slot just ahead of the cutter following. There is no screw or brad point, the circular rim acting as a guide. Although this bit bores slowly and, when driven in a drill press, must run at a comparatively slow speed, it is capable of producing the finest and most accurate work, it is supplied with either a straight shank for the drill press, or with a squared and tapered shank for the brace. The second bit of this type shown in Fig. 3 has a single cutter and a continuous saw-tooth spur. It is especially suitable for boring holes in thin wood and is supplied with a straight shank only. The fluted machine bit, Fig. 3, is similar to the metal drill except that it has two cutters two spurs, and a brad point. It is suitable

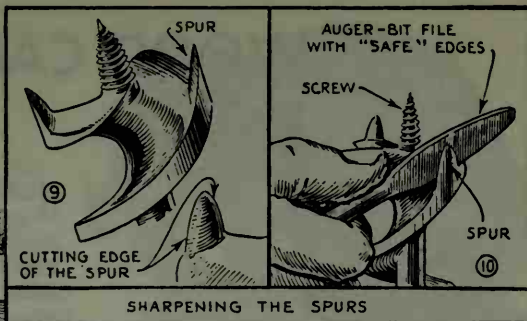


for high- speed work and is supplied with a straight shank.

One essential step to good work with a wood-boring bit is shown in Fig. 2. The jaws of the better grades of braces are curved and V-grooved and are opened and closed by tapered or beveled rings actuated by the outer threaded sleeve of the chuck. When chucking a bit it is necessary to see that the corners of the square shank are placed in the V-grooves and also that the shank is pushed into the chuck as far as it will go. To assure that the corners of the shank remain in the grooves, the jaws are opened just far enough to admit the shank. When the chuck is tightened, the bit will be straightened and held parallel with the axis of the brace. A bit in good condition will enter the wood and continue to bore with very little downward pressure on the brace, as in Fig. 7. Bits that are well cared for seldom need sharpening, but it is important that this be done properly. Fig. 8 shows how the cutters are sharpened with a special auger-bit file having one smooth or "safe" edge. The bevels on the cutting edges should be kept just as near the original form as possible. If, for example, the angle of the bevel is shortened, the chip will be curled tightly and the bit will tend to clog. Only the top of the cutter should be filed; never the bottom as this will flatten the clearance angle. When you file the cutters it's a good idea to touch up the spurs also. In filing the spurs, the important thing is to keep the original shape. With care, this can be done with the bit file as in Fig. 10. Notice particularly that the inside face of the spur is convex and that the sharp edge is continuous. It is necessary that the cutting edge be sharpened so that it will cut in either direction.



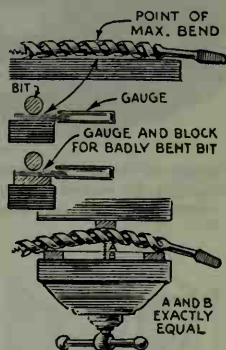
This prevents possible breakage should it be necessary to back the bit out of an unfinished hole. The smooth edge of the file should ride on the bottom of the cutter. The trick in filing is to take off an equal amount from each spur, the greatest care being taken in each filing to avoid reducing the thickness of the spur at the base. Likewise, when filing the cutter, care must be taken to round the end of the bevel at the point where it meets the solid center just above the screw. This can be done with a small round file, taking out the square corner formed by the filing of the bevel. Should this corner be allowed to



bore the hole easily, the dowel acting as a guide to keep the larger bit in line with the axis of the smaller hole. If you have to carry your bits with other tools, Fig. 12 shows one way of preventing damage to the head. Select a cork or dowel to fit each bit and, as soon as you have finished using the tool, turn the screw into the cork or dowel in the manner shown.

Straightening a Bent Auger Bit

If an auger bit is bent you can straighten it as follows: Place the bit on a perfectly flat surface and roll it until the point of greatest bend clears the table a maximum distance. Carefully measure this distance, using a thickness gauge, or, if the bit is extremely out of line, the gauge and a flat piece of metal of known thickness. Make two pieces of metal or hardwood having thicknesses exactly equal to the clearance distance, and fasten them to the ends of a hardwood block which is thick enough to resist bending when placed in the vise.



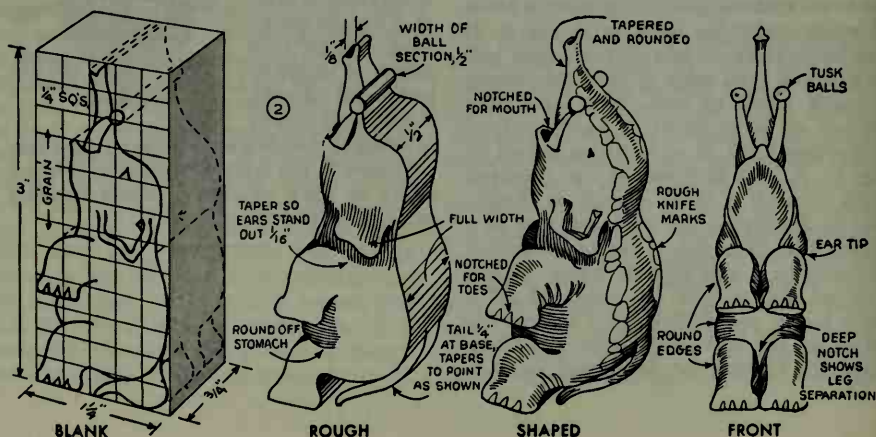
WOOD CARVING



"Jumbo on the tub" is simulated in a paperweight by mounting the carved elephant on the top part of an auto piston that has been cut off and polished

JUMBO the circus elephant is simple to whittle no matter what pose you choose. And you can use him in dozens of ways. Figs. 1 and 3 show him mounted on modern metal bases for paperweights, while Fig. 7 gives a third pose in which he serves as a simple knickknack on a desk or corner shelf. Other uses are a decoration for a cigarette box or a blotter handle, a letter opener, etc. His blocky shape requires only a little finishing—the rougher you leave him the more natural he looks. For a carving blank, pick a straight-grained, knotless piece of white pine or basswood, planed to about $\frac{3}{4}$ in. thick. You can make him fatter if you like, using a block 1 or $1\frac{1}{8}$ in. thick. On one side draw $\frac{1}{4}$ -in. squares, then copy the pose you want, three of which are shown in Figs. 1, 3 and 7. Other poses are suggested in Fig. 6. Be careful to draw the elephant so that the grain runs the long way of the trunk and tail, otherwise they are likely to split or break off during carving. The details in Fig. 2 are for a vertical pose, while those in Fig. 4 are for a horizontal one. Fig. 8 shows the head carving, which is more or less common to any pose.

To begin carving, cut out the blank with your penknife. Avoid making any edge a continuous curved line; it looks better as a



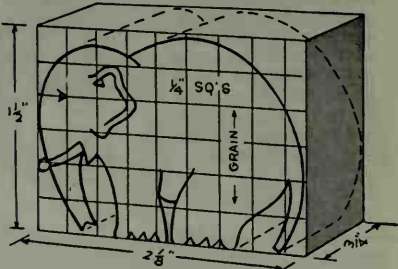
series of broken planes, just as your rough knife cuts would leave it. Cut a V-notch between the legs in front and back, and extend V-cuts up between the legs and body, Fig. 5. Thin down the tail and round it up. Cut a deep notch behind the head on each side. Now all that remains is the face. Outline the back of the ears with a straight-in cut about $\frac{1}{16}$ in. deep, then cut in diagonally from the body to remove a V-shaped chip. Follow this with a shallow V-notch to represent the ear itself, another V-notch and a shallow shaving inside the lobe to outline it. Mark the tusk position, then thin down the trunk, making certain that the outer surfaces are in line above and below. Accent the mouth opening, and round up the tusks, shaping the balls at their ends. Then carefully round up the head and trunk. If you are unfortunate and break off a tusk, cut both off and have a tuskless elephant. Remember to shape the little "finger" at the end of Jumbo's trunk, so he can pick up peanuts. The line of his lower lip marks the butt end of his tusks. Locate the eyes and cut in little pyramids to form them. Now cut a series of V-notches around each foot to simulate toes, and also behind any bent joints, under the jaw, etc.

To get a grayish-black elephant color, mix equal parts of brown, black and white oil paints to get a blue or brown-gray. Thin it a little more than usual, and daub it on liberally. When all areas are covered, wipe off the surplus paint with a cloth. This will give Jumbo a soft finish, with a little shine to accent the creases of his hide. Touch up the inside of his mouth, the tip of his trunk, his toes and his eyes with pink (red and white mixed). Paint his tusks white, with gilt balls. If you want a fabled white elephant, paint him a dirty, light gray all over—no elephant is pure white unless whitewashed. You can also carve a little palanquin and a mahout if you wish to put Jumbo really on parade. These can be glued on. In that case, carve V-grooves to show a headcloth and a body-cloth. Then paint them in gay colors.

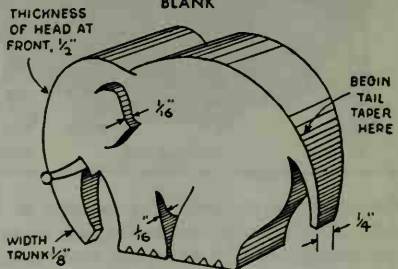
You can, of course, make such an elephant as elaborate as you wish—putting in



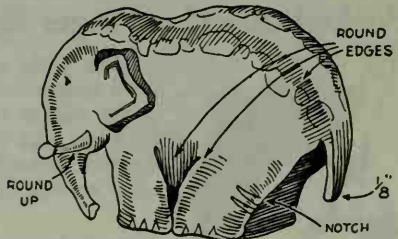
③



BLANK

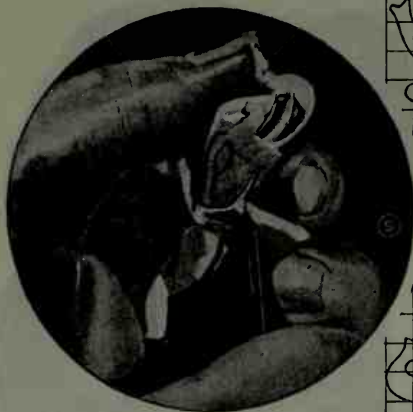


ROUGH

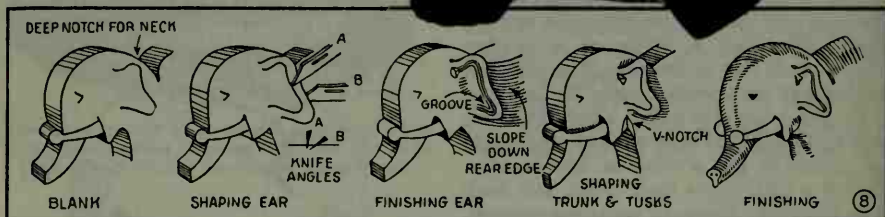


SHAPED

④



Use a sharp penknife for notching and grooving, and do not make any edge a continuous curved line. The figure looks better with all surfaces a series of broken planes just as left by the rough knife cuts



V-notches to simulate the creases in his hide. And you can use mahogany or walnut, and finish him by oiling and waxing. If you want him larger, use $\frac{3}{8}$ or $\frac{1}{2}$ -in.

squares. Or again, lay out the designs on $\frac{1}{8}$ or $\frac{1}{4}$ -in. wood and carve them as silhouettes for a wall frieze, picture-frame decoration, or wall panel.

Pocketknife Has Finger Shield for Carving and Whittling

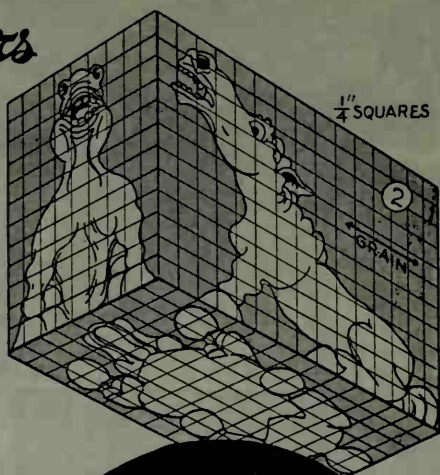


When using a pocketknife to carve or whittle wood, slip a small sponge-rubber ball over the blade, as indicated, on which to rest the tip of your index finger. You'll find that this keeps the blunt edge of the blade from "cutting" into the finger, which is rather painful when the knife is used for long periods. Once a slot is made in the ball it slips on or off easily.

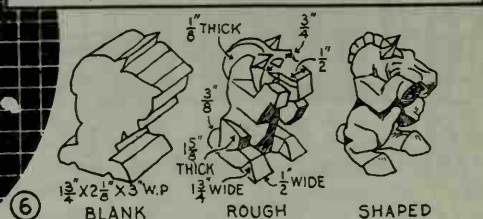
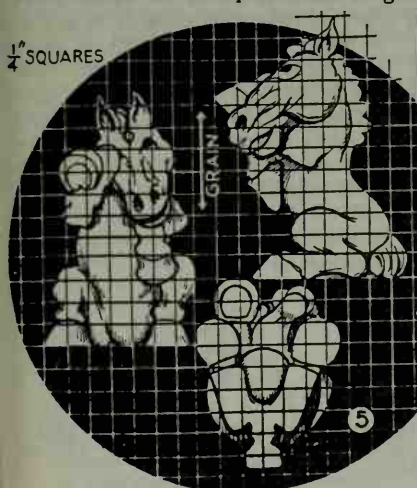
Small chisels for use in wood carving can be had by grinding ice picks to shape, taking care not to burn them.

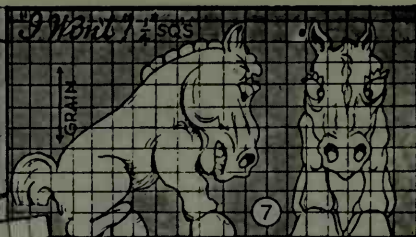
WOOD CARVING

simplified for beginners



WHITTLING caricatures in wood with a jackknife is a fascinating hobby that costs practically nothing and it may be a source of worth-while revenue, as small hand-carved pieces, especially of characterized animals, have become a popular fancy. Fig. 1 shows seven poses of a little stallion, which were carved from softwood. You can use white pine, sugar pine or basswood, or, if desired you can practice by carving in soap. To reproduce these poses in wood, first make full-size paper patterns of the front and profile views shown in the squared drawings in





Figs. 2, 5 and 7 to 11 inclusive. Then using carbon paper, trace each pattern on respective, adjacent faces of a squared block of wood. Place the pattern to correspond with the direction of the grain indicated in each pattern. This is important especially

when carving in wood, as small parts such as the ears are otherwise likely to break off before the carving is completed. For this reason it is best to carve the ears last. The approximate shape of the horse is obtained by first sawing out the rough blank. This can be jigsawed or cut by hand, using a coping saw as shown at the top of the page. Here you will find that a V-notched board, screwed to the top of a bench to allow it to overhang the edge, will be helpful in supporting the work while sawing. Saw the profile first, then temporarily tack the waste pieces back on the block to provide a flat surface, and saw out the front view. Figs. 4 and 6 show two poses in blank, rough and finished form, with dimensions for thickness at various points. If made of wood, the figure looks best when carved rather roughly as in Fig.

3, while a smoother finish is more desirable on soap or plastics. For the beginner, Fig. 12 suggests a simplified head which is less difficult to carve than the one shown for the advanced whittler. You can finish your model with either stain or paint, applying a darker color to the hoofs, mane, tail and nostrils to give contrast to a light body.



BLANK ROUGH SHAPED

SIMPLE HEAD



BLANK ROUGH SHAPED

ELABORATE HEAD

WOOD CARVING

Small Carved Birds Make Neat Ornaments



Carved or sawed from white pine or other soft wood, these miniature birds and houses make neat ornaments for mantels, Japanese gardens or bric-a-brac shelves, and, when fitted with pointed standards, they can be pushed into the soil around potted plants to produce a realistic effect. For most purposes, skewers or candy-sucker sticks make good standards, while toothpicks can be used as perches. The designs may be varied to suit your fancy, and the birds can be copied from life or from colored pictures. The martin house shown in the circular detail is carved from solid stock and has holes drilled through it to represent doors. In most cases the birds are simply glued on their perches. Although the birds have a more realistic appearance when carved, good results can be had by sawing them out in silhouette and then posing them properly. They may

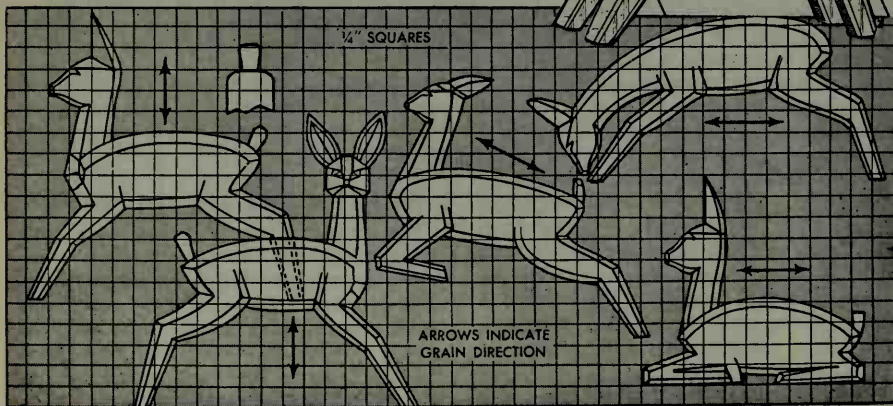
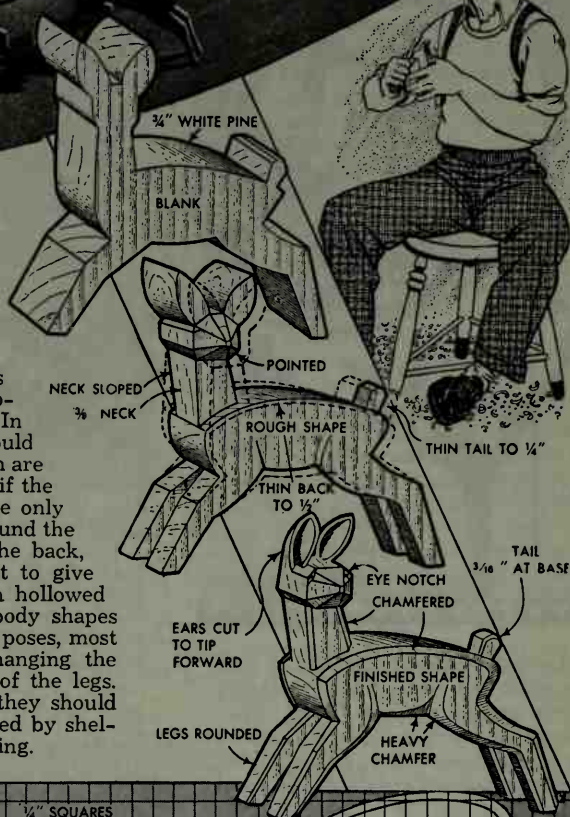
also be cut from cardboard with a pair of scissors. In this case, it will be necessary to reinforce the cardboard to prevent it from warping.

Wax Protects Wood Carving

Wood carvers who find that their work often cracks due to exposing the unseasoned center portion of the wood to the air, as the work progresses, can avoid this trouble by keeping the exposed surfaces coated with wax, a waxed cloth being kept handy to rub on the work each time it is laid away.

Whittle This Deer in Five Poses

HERE is an attractive little figure that even the most inexperienced carver can make with ease. Most of the work can be done on a jigsaw to produce a blank, which then is chamfered along the edges. The legs are now rounded and tapered toward a blunt point at the hoof. In general, the wood grain should follow the line of the legs which are fragile and likely to break off if the grain runs across them. The only careful carving required is around the ears, which are rounded at the back, undercut at the base in front to give them a forward tilt, and then hollowed out at the front. Head and body shapes are practically the same in all poses, most of which are obtained by changing the angle of the neck and shape of the legs. After the figures are carved, they should be sanded carefully and finished by shellacking and waxing or varnishing.

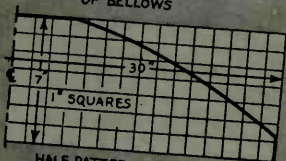


for Your Fireplace

LEATHER HINGE
UNDER BOOT

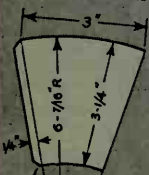


DETAIL OF FRONT
OF BELLOWS

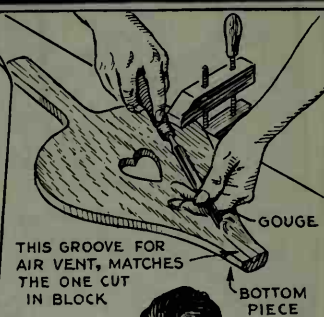
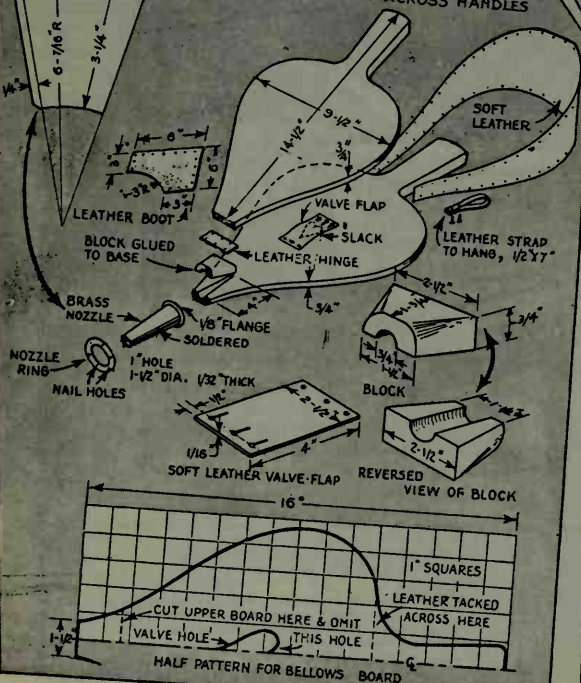


HALF PATTERN FOR LEATHER

NOTE—ALL EDGES OF LEATHER AND
BOOT ARE REINFORCED WITH A STRIP
OF LEATHER $\frac{5}{8}$ " WIDE, SECURED WITH
BRASS-HEAD TACKS $\frac{3}{4}$ " APART.



END VIEW SHOWING HOW LEATHER
IS CARRIED ACROSS HANDLES



THIS GROOVE FOR
AIR VENT, MATCHES
THE ONE CUT
IN BLOCK



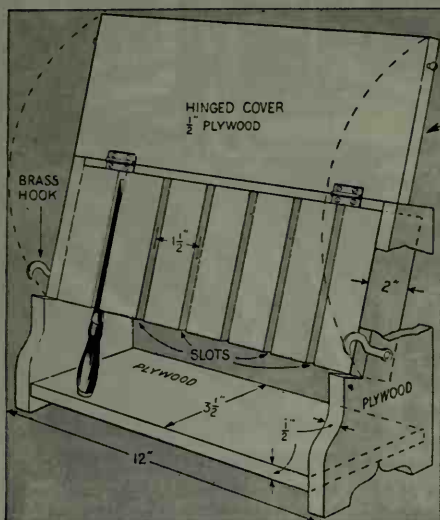
OPENING CUT
ON JIG SAW

SANDPAPER
WRAPPED ON
DOWEL

THE EDGES ARE
SMOOTHED AND
ROUNDED WITH SANDPAPER

WOOD CHISEL RACKS

Chisels Missing in Rack Noticed at a Glance

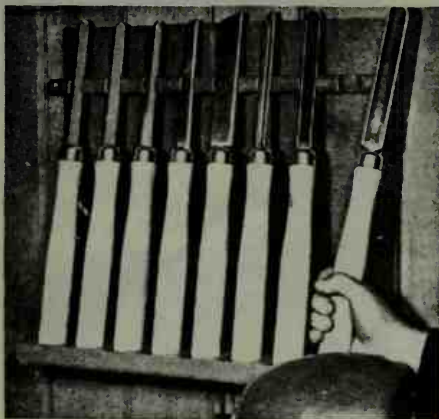


Accommodating a set of six or eight chisels, this rack will not only protect and keep them in neat order, but it will enable you to see at a glance if any are missing. The chisels rest edgewise in narrow slots cut in a 2-in. pine block, the length, width

and depth of each slot being cut to suit the individual chisels. The base and sides of the rack are cut from 1/2-in. stock, and two flat brass hooks keep the hinged cover closed. If desired, the rack can be screwed solidly to a shelf near the workbench.

Rack for Wood-Turning Chisels Permits Easy Removal

I find this open rack for wood-turning chisels much more satisfactory than clip



hangers, slotted boards or other devices. A tool can be removed or replaced in an instant without getting caught on anything. The base is a 3/4 x 5 x 17-in. board supported on shelf brackets. The tool handles rest in large holes bored part way through the wood, these holes being continued through the wood with a smaller drill to permit easy removal of the shavings. The tool blades fit in open cuts in a 1 1/2-in. strip nailed to a backboard. The tools are tilted back sufficiently to prevent them from falling out.





FANCY WOODS from your back yard

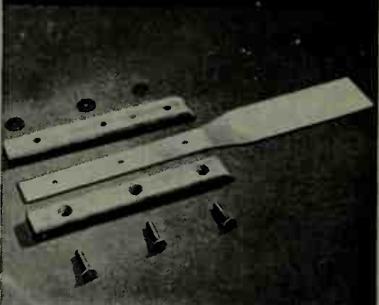
CHOICE pieces of fancy woods that are ideal for small turnings, such as tool handles and similar projects, are available right in your own back yard. Wood from an apple or cherry tree finishes beautifully and is well suited to turnings and the carving of small novelties. Large stems of some rose bushes, being of tough and close-grain wood, are excellent for tool handles. Catalpa wood, while relatively soft, has an interesting grain.

Often, the dead branches of a bush or tree will be dry enough to use right away but in other cases the wood will have to be seasoned before working it to shape. This is done by stripping the bark from the branches and then storing them overhead in a garage or dry basement. Paint both ends of each piece with asphaltum to prevent checking. After a few months of air-drying, the pieces will be ready for use.

The spatula pictured in the photos at the right is an example of what can be done with home-grown wood. Here, wood from the stem of a rose bush was used to form the handle. First the wooden parts are planed flat on one side and cut roughly to size. Then they are clamped to each side of the spatula tang and all three parts drilled at one time for three flat-headed rivets. Holes in the wooden parts are countersunk slightly to take the rivetheads and the burrs on the peened ends. A file is used to dress the rivets flush with the wood and, finally, the handle is worked down to the desired shape with sandpaper. A coat of stain followed by two coats of clear lacquer and rubbed to a high polish brings out the beauty of the wood.



Removing bark of dead rose-bush cane. Wood is then allowed to dry thoroughly

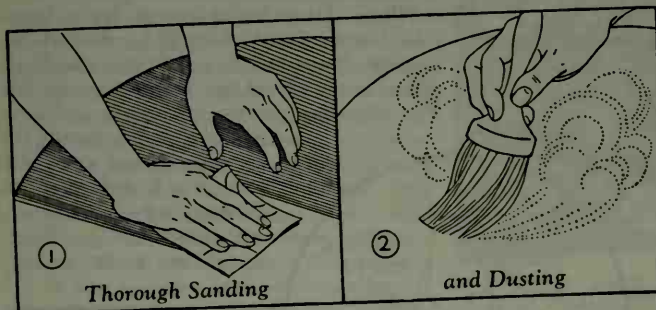


A length of rose-bush cane, split down the middle, is used for spatula handle



Assembled to spatula with brass rivets, handle is sanded, stained, lacquered

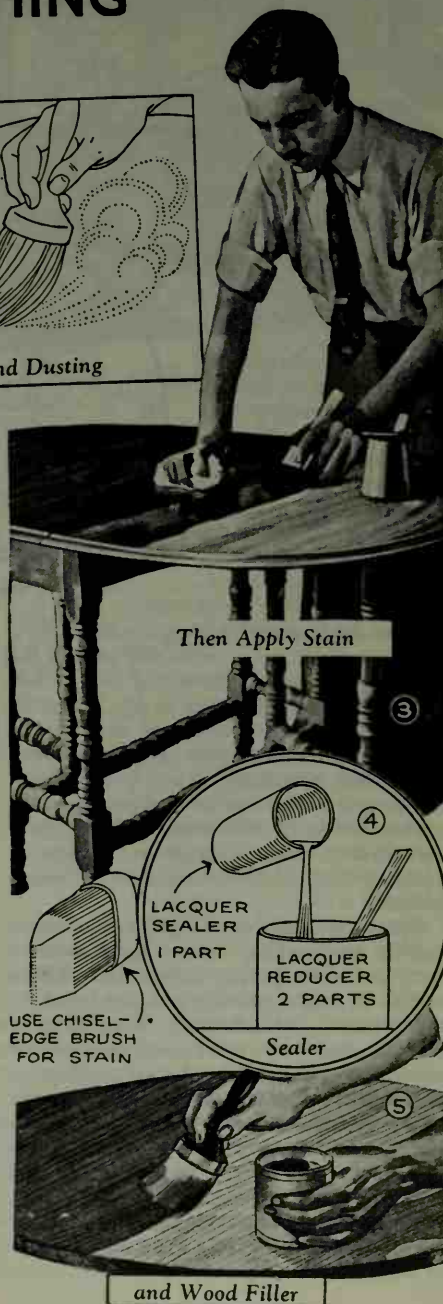
WOOD FINISHING



HOW does the expert produce the soft glow of finely finished wood? How does he give his work that unmistakable professional appearance? He will tell you that there are over twenty operations in a top-rate job of hand-rubbed finishing, and that most of these steps have to do with careful and intelligent attention to small details, simple things that one is apt to overlook. The other operations have to do with applying the right materials in the proper sequence.

Sanding: In starting with any article not previously finished, you first go over the piece thoroughly with fine steel wool, then No. 7-0 sandpaper, Fig. 1. A helpful trick is to use a large piece of old inner tubing or other flexible pad, wrapping the sandpaper around it to reach into crevices more easily. Clean up all tool marks. Dust off with a dusting brush as in Fig. 2, or with compressed air if available. Sand and re-sand. A thorough sanding job is the beginning of a good finish.

Staining: First apply a thin glue sizing, allow it to dry and sand lightly. Water-soluble aniline dyes which are best for staining mahogany, for example, have been transferred to anhydrous solvents. Water stains of this type are non-grain-raising, have a clear color and tone and do not clog the pores because they are completely dissolved. The water stain will accentuate the beauty of the grain more than most oil stains. Walnut and mahogany will respond beautifully to this treatment but when you





use other woods and endeavor to give them a walnut or mahogany finish, you are obliged to consider the wood, rather than the color of the finish. If, for instance, you are using one of the Philippine woods which are often mis-called Philippine "mahogany," you are not dealing with mahogany at all. It is said to require extra work and care in the finishing. Some finishers say that it requires excessive sanding to lay the grain properly, absorbs excessive amounts of finishing materials, and remains lifeless. To imitate mahogany, select birch. Using the proper stains and procedure sequence certain pieces of this wood will finish in a remarkably close simulation. Likewise, selected cherry can be finished to match walnut.

Spray the stain very lightly on a thoroughly wet surface—unless the directions with the stain preparation advise differently. Or, use a sponge or large brush to apply thinly, but delicately. Then allow to dry, scrutinize the result, and re-apply, if necessary. Wood, such as mahogany, darkens with age. It may be a light salmon pink when freshly cut, and change to a sherry with time. Your job, therefore, is to achieve this sherry tone immediately. Naturally dark stains are positively out. The object is to bring out grain by intensifying it with successive light applications of stain, Fig. 3.

First Sealer Coat: Allow the stain to dry for four hours or more. The sealer coat, Fig. 4, consists of alcohol, 4 parts, to four-pound-cut white shellac, 1 part, or, use lacquer sealer, 1 part, to lacquer reducer, 2 parts. The sealer coat brings out the highlights and makes it more transparent. If possible, spray it on as in Fig. 8.

Filler: Allow sealer coat to dry at least four hours. Sand thoroughly, dust thoroughly. A secret is to use filler, regardless of the character of the wood. Experts do. The filler for the job should be of inert

material and it should be a shade darker than the stain, Fig. 5. Add pigment as desired—for brown mahogany, use Van Dyke brown or burnt umber;



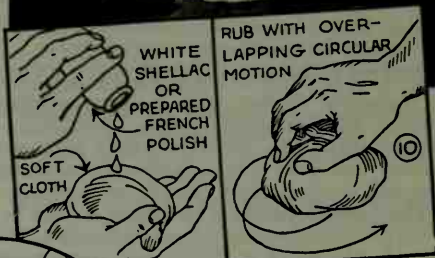
for red mahogany, use burnt sienna and Van Dyke brown; reduce with naphtha and brush on with the grain. In 4 to 8 min., wipe across the grain with circular motion, using burlap. On turned parts proceed as in Fig. 7. Wipe until completely clean. Dry overnight, preferably in a warm room. Do not rush—the old wood masters never did.

Second Sealer Coat: Spray on as in Fig. 8 if possible. Make this coat slightly heavier—a little less reducer. Dry at least one hour. Sand with No. 7-0 sandpaper and don't forget to remove dust.

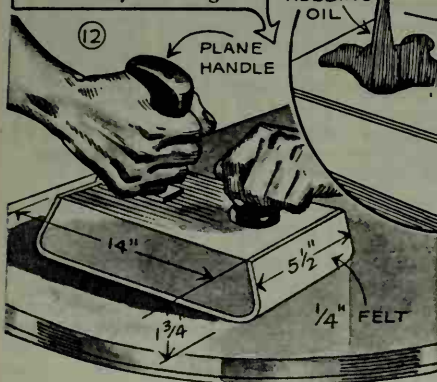
Glazing: To achieve an antique finish,

with certain parts highlighted at the corners of flat surface, around grooves, legs, and knobs—apply glazing stain, rubbing it off except in the parts just mentioned. Allow to dry overnight. Or, for an antique look on the piece, use a special antique stain in the staining process. The dealer in decorators' or wood finishers' supplies will tell you which.

Finish Coats: Clear lacquers are generally preferred by professional finishers. Good lacquers are quick-drying, resist water, heat, alcohol, scratches and are easily washed with soap and water and polished. The new synthetic varnishes which have a Bakelite base, are excellent, too. Also, shellac with a polishing-off wax will give you good service. But most satisfactory as a rule, is good lacquer. Three coats, with 48 hrs. between each coat, and sanding between each—is the usual procedure. Use an air brush for lacquer, if possible. Apply a gloss lacquer for the first two coats, then a flat type for the third to give extra body. Lacquer all over—front, back, inside. For a less dull effect, use a soft cloth or felt dipped in rubbing oil, Fig. 11, then in American



This Pad Eases the Task of Rubbing



ground Italian pumice stone and rub gently. For a still duller effect, use pulverized pumice and water. Wash off and dry with chamois. Polish with paste wax. When the wax has been absorbed, wax some more, rub some more, wax and rub and so on and on as long as possible. The pad shown in Fig. 12 will help out on this job. The

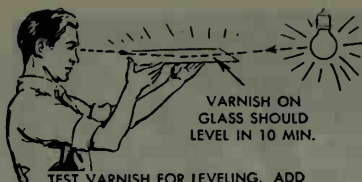


Preparing Pad for French Polishing

beauty grows in direct proportion to the amount of rubbing you do.

French Polishing: This is an interesting antique finish in which there is a maximum of hand rubbing. Sandpaper, stain, etc., omit lacquering and instead apply raw linseed

oil. Let it dry 24 hours. Sandpaper again using No. 7-0 paper. Dust. Dissolve French polish or shellac gum with alcohol to a very thin liquid. Apply with pad, using circular motion, Figs. 9 and 10, adding just a drop of raw linseed oil, now and then. When the surface of the article has been gone over in small sections, this way, about four times, set it aside and allow to dry 48 hours. Repeat the process at intervals of 48 hours as long as you like, except that the final rub-down ought to take place six days after the preceding, just to give the second to the last coat time to season. The beauty grows with each polishing.



TEST VARNISH FOR LEVELING. ADD TURPENTINE OR HEAT IF TOO HEAVY



Varnish is your best finish for brushing. One coat of sanding sealer and one coat of rubbing varnish is recommended for quick, easy job

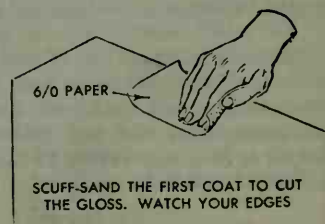
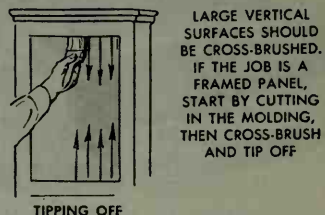
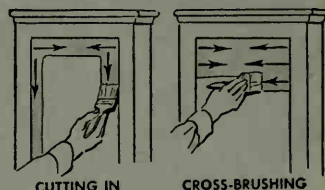
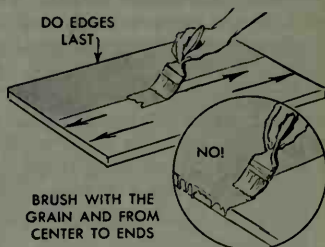
WOOD FINISHING

SEVERAL common materials are used for top coats, including shellac, wax, lacquer, varnish and synthetics. All are good finishes. Generally, if you are using a spray gun, nothing beats a lacquer system for quality furniture work. If you are swinging a brush, you will do best with varnish or brushing lacquer.

The varnish finish: Varnishing should be done in a clean place made as dust-free as possible. The temperature should be 70 to 80 degrees—remember that varnish is like oil or grease and flows best when warm. A flow test on glass, as in the top drawing, is a worthwhile check. Poor flow can be corrected by thinning the varnish, or, if simply a case of too low a temperature, by heating in a pan of warm water.

The first coat of varnish goes on better and sticks tighter if thinned with gum turpentine, 1 part, to varnish, 4 to 6 parts. Your brush should be a good quality varnish brush, 1½ to 2 in. wide. Start on surfaces you see the least; finish with what you see the most. So far as practical, all large surfaces should be worked in a horizontal position. Dip your brush a little more than one third the length of the bristles and then set the varnish in the brush by tapping lightly against the edge of the container. Apply the varnish with a deliberate, smooth stroke. On a table top, brushing should be from center to ends, as shown. After the surface is covered, tip it off with light brush strokes running from one end to the other. On a framed panel, cut in the molding first, as shown, then cross-brush and finally tip off with the grain. Cross-brushing is a useful technique to obtain a level coat, especially on a vertical surface; it is not needed when the surface is horizontal. A film of varnish or other clear finish is almost impossible to see and it is important to have strong lights suitably placed to make the wet surface glare in your eyes.

Let the first coat dry 12 to 24 hrs. and then sand lightly with 6/0 garnet to knock off the gloss. Be careful not to sand through the finish, especially at the edges. Apply the second coat at can consistency. Give this second coat plenty of drying time—never less than 24 hrs.



LARGE VERTICAL SURFACES SHOULD BE CROSS-BRUSHED. IF THE JOB IS A FRAMED PANEL, START BY CUTTING IN THE MOLDING, THEN CROSS-BRUSH AND TIP OFF

6/0 PAPER

SCUFF-SAND THE FIRST COAT TO CUT THE GLOSS. WATCH YOUR EDGES

VARNISH

VARNISH is composed of a gum or resin in a suitable carrying agent or vehicle, commonly linseed or tung oil. Solvent oils — usually turpentine — are added to make the varnish thin and fluid. Many different kinds of varnishes are made, the list below covering products of special interest to the wood finisher.

RUBBING AND POLISHING — Rubbing-and-polishing varnish is designed specifically for furniture finishing. It contains a smaller amount of oil than other varnishes and is generally described as a short-oil varnish. Short-oil varnishes sand and polish with a minimum of gumming. Drying time is usually 24 to 48 hours. Four-hour-drying products are also available.

PALE RUBBING AND POLISHING—Same as above but very clear for light-color finishes.

POLISHING VARNISH—Shorter oil content than regular. Polishes nicely but tends to be brittle. Use only as top coat over regular rubbing varnish.

TABLE TOP—Hard and tough, proof against heat, cold and alcohol. Usually a synthetic. Four-hour dry.

SPAR—Long-oil, dark, slow-drying, moderate gloss. The long-oil content makes this varnish tough and elastic. Used most for exterior work; sometimes called marine varnish. Dries hard in 12 to 24 hrs.

RUBBED EFFECT—Dries to a satin finish resembling hand-rubbed work. Best used for top coat only; use regular gloss varnish for undercoats.

VARNISH STAIN — General-purpose interior varnish tinted with dye colors or pigments. All wood colors. Stains and varnishes in one coat. Good for pine floors; seldom used on quality furniture except as quick refinish.

SANDING SEALER—A product designed for a first coating over stain or filler. Usually a brushing lacquer or a shellac base sealer, either of which can be used under any kind of varnish.

SHELLAC

SHELLAC is a gum produced by the lac bug of India. The dried flakes are mixed with alcohol, the average store product being a 4-lb. cut (4 lbs. shellac per gallon of alcohol). Dries out of dust in about 10 min.; 2 hrs. to recoat. Only fresh shellac should be used, as mixtures over six months old tend to gum and do not dry properly.

ORANGE—The natural shellac color. Suitable for all dark woods.

WHITE—Bleached flakes produce a clear, transparent solution. This is the product most used for floors and furniture work.

SHELLAC MIXING LACQUER—See under LACQUERS.

WATERPROOF SHELLAC—A modified shellac which is completely waterproof. Most products of this type are closer to being brushing lacquers than shellac.

DEWAXED SHELLAC—A superfine bleached and dewaxed shellac commonly used as the basis for various kinds of French varnish.

LACQUER

LACQUER commonly indicates a product containing nitrocellulose, although the term is used for a wide variety of quick-drying materials. The nitrocellulose—cotton fibers treated with nitric and sulphuric acids—is blended with suitable solvents, gums and pigments.

CLEAR GLOSS—A clear lacquer which dries with a glossy finish. Thinned with lacquer thinner. Must be sprayed; dries too quickly for brushing. Dries dust-free in a few minutes; 1 to 2 hrs. to recoat.

CLEAR FLAT—Same as above but dries flat. Can be intermixed with a similar-brand gloss lacquer.

RUBBED EFFECT—Semigloss.

BRUSHING—A slow-drying lacquer suitable for application with a soft brush. Should be thinned with a slow-drying thinner for best results; often sold at brushing consistency.

RUBBING AND POLISHING—Made especially for rubbing and polishing. Generally, simply the better grades of lacquer. Usually water-white. Also called piano-finishing lacquer.

WATER WHITE—Perfectly clear, water-white lacquer. Should be used for all blond finishes, also as a protective coating for art metals.

SHELLAC MIXING—A lacquer which mixes with shellac, giving increased resistance to water and better sanding qualities.

BLEACHING—Bleaching lacquer is simply a water-white, thin lacquer, the kind of finish which is required on extremely light-color woods.

BAR TOP—Indicates proof against alcohol, heat, cold, etc. Used for table and bar tops.

NONLIFTING—Nonlifting lacquers are intended for refinishing over varnish. The solvent commonly used has high alcohol content; if reduction is required a nonlifting (high alcohol) thinner should be used.

SANDING SEALER—Contains a sanding agent which permits clean, easy sanding. One hour to sand.

BLONDING—A thin white lacquer used to obtain blond tone. Can be made by adding white lacquer, 1 part, to clear lacquer, 4 or 5 parts.

SYNTHETICS

SYNTHETICS are finishing materials using manmade resins. Most of the fast-drying varnish and enamel you buy today is synthetic. Most synthetics are sold simply as varnish or paint; some are identified by trade name only.

PLYWOOD SEALER — Especially good for equalizing hard and soft areas in fir and pine. Clear amber; also in white for blond effects.

PENETRATING FLOOR SEALER—A penetrating finish for floors but good for simple finish on furniture. Apply to bare wood only; brush, mop or spray. Low luster. Usually steel wooled and then waxed.

CATALYST FINISHES—Hard, tough finishes which are proof against steam, alcohol, etc. Used for table tops. Requires catalyst (hardener) which is mixed with synthetic before use. One to four hours to dry.



Sealer system with varnish: A first coat of varnish as just described is sound practice, but it takes 12 to 24 hrs. to dry. Faster work can be done with a first coat of a special product known as *sanding sealer*. This dries to recoat in about an hour. It brushes easily, has good build and—best of all—contains a sanding agent which permits clean, powdery sanding without gumming.

The shellac finish: This is an old standby, favored by craftsmen because it is easy to apply and dries fast. White (clear) shellac is used for most work and is a *must* for blond finishes. Orange shellac is used for dark wood. Intermixing of colors is practical. Deeper colors are sometimes useful in toning a finish where the stain does not seem exactly right. These transparent toners are easily made by mixing alcohol-soluble powder stain with alcohol and then adding to the shellac as required. The same trick can also be done with varnish and lacquer finishes, using oil-soluble and lacquer-soluble powder stains.

The main fault of shellac is that it goes stale. About one year after it is made, a chemical change has advanced to the stage where the shellac is so gummy it simply will not dry. For this reason, shellac should be purchased in small cans as needed, from a store where there is good turnover. Shellac is also thirsty; you should avoid warm, muggy days for your shellac work. You can do much to remedy these faults of shellac by buying a can of shellac-mixing lacquer. Mix the two together and you have a crisp-drying product which combines the excellent sealing action of shellac with the wa-

ter resistance and the hardness of lacquer.

To apply shellac, use a soft varnish brush. Since the material dries quickly, it is necessary to work rapidly, using long running strokes—one stroke to apply, one stroke to tip off. The use of thin coats makes brushing much easier; never use heavier than 3-lb. cut. If you brush excessively, the shellac will pile up in ridges and show laps. Shellac is rubbed down between coats with fine sandpaper or steel wool. The final coat can be steel-wooled or rubbed with 2/0 pumice and rubbing oil. Shellac is not water-proof and should not be water-rubbed.

Wax finish: For a simple, fast finish, wax has long been a favorite. It has a pleasing luster and is readily renewed. The first step in this finish is to apply at least one coat of thin shellac, varnish or lacquer. After this has dried, it is lightly steel-wooled and is then coated with paste wax applied in an even film with a cloth. Allow 10 min. to an hour for the wax to dry and then rub briskly with a soft cloth. Let dry for at least an hour and then repeat. Two coats of wax make a good finish.

Brushing lacquer finish: This is a good type of finish which deserves more use. Most beginners avoid brushing lacquer, perhaps having tried at some time to brush spraying lacquer or heavy lacquer enamel. You just can't do that because the material in the brush dries before it flows and in no time at all you are trying to paint with a snowball. A practical brushing lacquer is very thin—almost like water. It brushes as easily as shellac. "Brushing" is really the wrong term to use—you "lay" on a brushing lacquer or other fast-drying finish.



Apply a full wet coat when spraying lacquer. On table tops, always start at the near edge so that spray dust will be directed to the uncoated surface

Keep the brush wet, lay the finish on with one stroke, and you will get a smooth finish. The usual back-and-forth brushing action is especially taboo on the second coat because this movement will stir up the coat already applied. Two coats make a satisfactory finish.

Sprayed lacquer finish: This is the best and fastest way to finish furniture. The rapid drying of lacquer solves the problem of dust in the finish, and this in itself is enough to justify its use. The weakness of the lacquer finish is that it is thin. Some people like this thin finish. It is appropriate for wall paneling, especially when the wood is of a medium to light color. On dark woods, it may give a "starved" look, lacking the illusion of depth which is one of the characteristics of varnish. Good body can, of course, be built up in a lacquer finish, but it takes more coats. Lacquer can be applied in straight coats. More often a sanding sealer is used for the first coat since this is equal in build to two coats of lacquer. Sanding between coats is confined to a mere scuffing with 6/0 paper to knock off dirt nibs.

Penetrating finish: This finish was developed for use on floors, the idea being to obtain a finish which is *in* the wood rather than on it. Since there is no heavy surface film, there is nothing to wear or scratch. Penetrating finish is made in both wax-resin and resin-oil bases. Both must be applied to bare wood only. The wax type cannot be coated with any other type of material; the resin-oil base can be topped with varnish at any time. The chief fault of penetrating finish is that the finish lacks body, often giving the appearance of no finish at

all. The luster can be improved by waxing. A wax-base product is preferred for furniture. Application is made to the bare or stained wood with brush or cloth pad. No filler is required since the finish provides its own filler. After drying one hour or until tacky, the excess is rubbed off with 2/0 steel wool. A second coat is applied and allowed to dry 4 hrs. or more and is then rubbed down with 2/0 or 3/0 steel wool. Polishing with a soft cloth will bring up a soft luster and the polish can be renewed at any time by rubbing with a cloth. These specific directions apply to a specific product; use the application methods recommended by the manufacturer of an individual product.

Catalyst finishes: Catalyst finishes embrace a group of liquid-plastic materials which are cured by means of a catalyst or hardening agent added to the material just before application. Finishes of this kind are usually sold under a coined trade name, a typical product being Phenalin. Characteristic features are extreme hardness and "proof" against almost anything, including boiling water, alcohol, lacquer thinner and even varnish remover. A finish of this kind is often useful on bar and table tops and other surfaces which are abused in various ways.

The amount of catalyst varies with different products. Phenalin takes 1½ oz. per quart. This specific product is best sprayed but can be brushed; it dries enough in 1 hr. for the first coat to be sanded. The second coat requires 24 hrs. drying time before rubbing. All finishes in this group have poor adhesion to undercoats and should be applied to bare or stained wood only—do

not use any kind of sealer or pigmented stain. Rubbing can be done with rubbing compound or with waterproof paper, using grits 360 and 400 in succession with rubbing oil or water lubricant. Many catalyst finishes, especially the urea-alkyds, require baking in order to properly cure the surface film. Phenolic resins used with a catalyst usually are air-dry-or-bake type. On small objects, baking equipment need not be elaborate since it can be done quite nicely with one or two infrared heat lamps.

Salad-bowl finish: Another useful industrial finish which is now available in the craft field is a penetrating finish for salad bowls and other woodenware. Salad-bowl finishes are made in one and two-coat systems. In a single coat, the feature of the finish is deep penetration of a wax-resin solution. A two-coat system is a continuation of this film with a special type of lacquer. The general idea is that the wood is impregnated and also coated with a tough, waterproof film. The salad-bowl finish is a lacquer formula but can be brushed. A warm room is required—especially if you are spraying—to keep the wax content from going out of solution. This finish has a waxy feel and is excellent for cigarette boxes and other items touched by the hands.

Finishing fir plywood: Fir plywood is a difficult wood to finish with ordinary materials because of the wild grain and the fact that the wood tends to fuzz and face-check. These faults can be overcome to a considerable extent with the use of phenolic resin primer, commonly sold as plywood sealer or marketed under a trade name (Rez, Firzite, etc.). The sealer is also useful for pine and fir other than plywood. A full wet coat should be applied to bare wood, using brush, spray or cloth mop. Let dry a few minutes and then wipe clean with a soft cloth. The surface is dry for handling almost immediately but should dry overnight for top coats of varnish, shellac or lacquer. If a dark stained finish is desired, the preferable technique is to apply pigment oil stain over the sealer. The clear sealer can be mixed with colors-in-oil to make a stain for this purpose. Clear sealer can also be mixed with white oil paint to make a filler for limed effects or a wipe-off stain for blonded finishes. A ready-mixed white sealer of this type (white Firzite) can be purchased at most paint stores. It should be noted that the terms *white sealer*, *white-pigment wiping stain*, and *white toner* indicate the same general technique of staining a piece of wood with a semitransparent surface coating. The white sealer is primarily for fir plywood, where its sealing and penetrating action is more important than the fact it also contains white pigment which colors the wood. White-pig-



Delta photo

Above, applying white plywood sealer for a frosted finish. Below, clear plywood sealer is a good first coat when giving fir plywood a blonding treatment



Catalyst-type finish is hard, acidproof. A hardening agent (catalyst) is added immediately before its use

ment wiping stain is purely a stain, and its only purpose is to color the wood; it has very little penetration. A white toner commonly means a lacquer product; it is definitely a surface coating with no penetration of the wood.

WOOD FINISHING

On home-shop furniture projects the final touch of the craftsman is best expressed in a hand-rubbed finish



THAT GLASS-SMOOTH satiny finish you see on high-grade furniture is still done by skillful hand-rubbing with powdered abrasives. What happens to the surface of the finish during the rubbing process is shown graphically in Fig. 1. Rubbing the dry finish removes brush marks, orange peel (the wavy effect caused by spraying lacquers without the proper retarders), dust specks and bubbles. All are common defects and are almost impossible to avoid in some degree unless the finish can be applied under ideal conditions of dust-free air and rigid temperature control. The first rubbing removes defects and levels the finish, giving it a dull, flat appearance. Then the surface is brought to varying degrees of sheen, or gloss, with a flour-fine abrasive and a final polishing. In current practice the finish is left dull flat on antiques. For period furniture a semigloss is preferred but on modern designs the finish usually is rubbed to a high satin polish.

Although rubbing may be done with a cloth pad, a thick felt pad is best. Felt has just enough "give" to follow slight irregularities without danger of cutting through the finish. Powdered pumice, FFF grade or finer, is commonly used for the first rubbing. Pour the powder into a tumbler of water as in Fig. 2 and allow it to settle. Then pour off most of the water and mix to a creamy paste.



BEFORE RUBBING



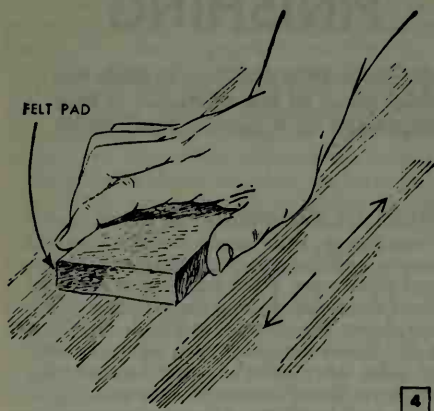
AFTER RUBBING

1 Pour abrasive powder into a glass tumbler about two thirds full of water and allow to settle. Then pour off most of the water and mix to a creamy paste

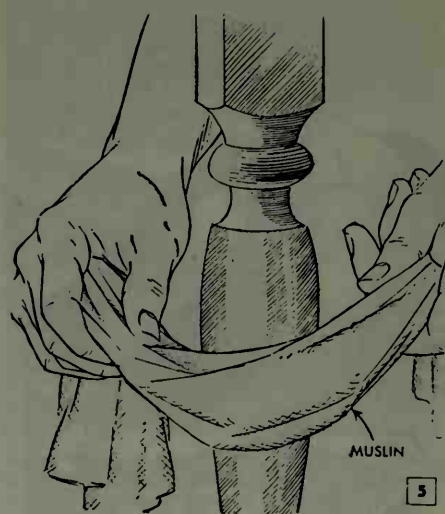


Brush the paste onto the surface to be rubbed, applying it in a thin film of uniform thickness. Be sure that the brush used is clean and free from grit

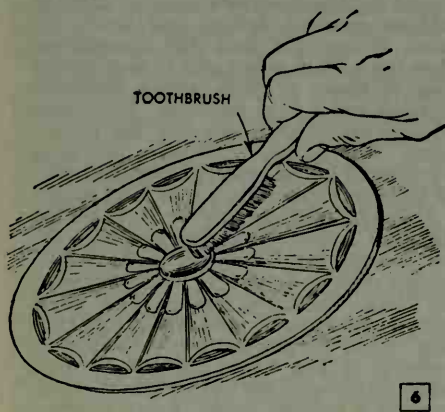




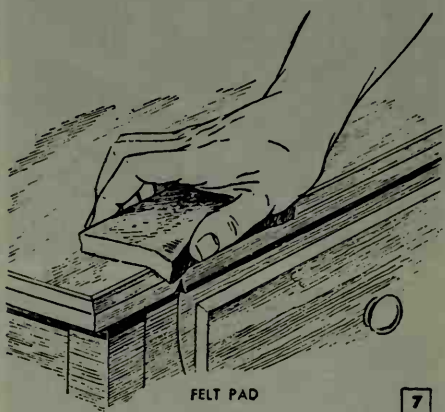
Use a felt rubbing pad for polishing flat surfaces with the grain and make sure that the pad is clean



Turnings can be polished with a clean cloth charged with abrasive cream. Use only light polishing pressure

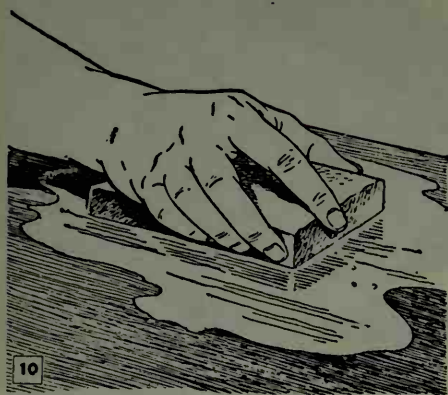


Above, paint small carvings with abrasive cream and polish with a toothbrush. Below, some finishers apply wax with a cloth pad to get a uniform coating



Above, be careful not to cut through finish when sanding or rubbing corners and edges. Below, some finishers prefer to apply paste wax with a steel-wool pad





Before polishing certain types of work, finishers go over it lightly with 8/0 wet-or-dry sandpaper and oil



Expert finishers often polish varnished work simply by rubbing the surface with the palm of the hand

prefer rubbing oil instead of water. In either case, mix the powder and liquid to a creamy paste and pour or brush it on the surface to be rubbed, Fig. 3. In rubbing with the abrasive-charged felt pad, use a long sweeping stroke, Fig. 4, each stroke overlapping the previous one about half the width of the pad. Always rub with the grain on straight-grained woods and the long way of the surface on panels or tops having a burred or butt graining. Be especially careful when working near the edge, Fig. 7, allowing the pad to overlap the edge on only one or two strokes at the most. Otherwise the abrasive may cut through the finish and expose a narrow line of bare wood. Check the progress of the work occasionally by wiping a spot clear of abrasive and examining it carefully in a good light. An easy way to determine the uniformity of the surface is to look across it obliquely. Small areas that are still rough or untouched are easily spotted in this way. When the surface is uniformly flat and feels smooth to the touch of a finger, it is ready for final polishing.

Turned legs, pressed or carved moldings and both overlay and relief carvings require a different treatment. Turnings are rubbed by means of an abrasive-charged muslin cloth as in Fig. 5, special care being taken not to rub the finish off the high places. Small carvings are rubbed with an old toothbrush after painting the surface with the abrasive cream. On large carvings a worn scrubbing brush is often used to advantage. In finishing carvings be careful to brush as much as possible lengthwise of the high places, not across them. This often will require brushing in several directions. As a rule, carvings and the short-radius portions of turnings are left in a

dull gloss finish. When a lathe turning is the project, rubbing can be done with the work turning at slow speed, Fig. 15.

In polishing a finer abrasive is used. Also, it should be noted that if nothing but water is added to the 3F pumice slush, Fig. 13, continued rubbing will grind the abrasive finer and finer. A thorough rub with pumice will produce a medium-low sheen. Leave the spent rubbing slush on the work. Then make a final rub with clean cotton waste.

For a polished finish, let the work stand overnight and then continue the rubbing process, using rottenstone and rubbing oil or water. Rottenstone does not actually cut like pumice but it will bring up a polish quickly if the work has been pumice-rubbed absolutely level. After rubbing, clean thoroughly with a damp rag.

Lacquer presents a harder surface than varnish and is often rubbed with wet-or-dry abrasive papers which cut faster than pumice. Even if you prefer the soft action of pumice, a quick cut-down with 8/0 paper lubricated with water or oil, Fig. 10, will greatly lessen the labor of pumice rubbing. The paper should be soaked a few minutes in water, Fig. 12, as the backing is weak and brittle when dry. A satisfactory satin finish, can be obtained with 8/0 paper alone, but can be followed by rottenstone or rubbing compound for higher gloss if desired.

Rubbing compounds are available in a variety of types and grits for coarse or fine polishing. In all types of rubbing, they are preferred by many finishers to the older pumice and rottenstone abrasives. Compounds are supplied in paste form and may be used with or without a lubricant, depending on type.

Within the scope of rubbing technique, French polishing is worth considering.



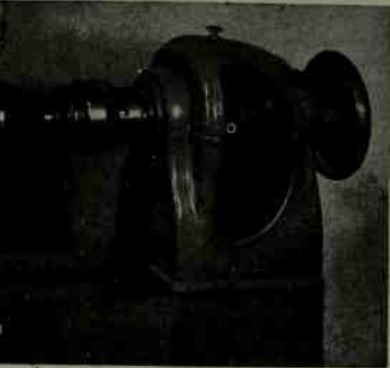
Wet-or-dry abrasive paper should be soaked in water for flexibility and strength. Right, in the final stages of pumice rubbing, add water to the spent slush to reduce cutting action



Don't try this with homemade mixtures of shellac and alcohol—buy a good ready-made product and you will be surprised how easily and quickly you can give any varnish or lacquer surface a high gloss. First, give the finish a good rub with 8/0 paper and water. Dry thoroughly. Pour a little of the polish on a soft cloth or gauze pad, and apply to the work with a circular motion, Fig. 14. Add more polish as needed. Make a final wipe with long sweeping strokes with the grain.



Frenching with a ready-made polish is an easy and fast way to build a high polish. Left, turned projects can be rubbed or polished while revolving in the lathe



WOOD FINISHING

basic schedules



OPEN-GRAIN WOOD

1

*Brushing or spraying, single-stain system
for oak, walnut, mahogany, etc.*

1. Brush or spray NGR stain of desired color. Dry 20-30 min.
2. Brush or spray wash coat of lacquer or white shellac. Dry 10 min.
3. Sand 6/0 garnet, dry. Dust off.
4. Fill with paste wood filler of desired color. Dry 30 min. to 24 hrs. depending on product used.
5. Brush or spray wet coat of sanding sealer. One hr. dry.
6. Sand 6/0 garnet, dry. Dust.
7. Second coat of sealer. Sand as before.
8. Spray two coats of clear gloss lacquer, or, brush one coat of R & P varnish. Lacquer should dry overnight; varnish at least 24 hrs. before rubbing.
9. Rub to satin finish with rubbing compound applied with burlap pad.

NOTES: Rubbing can be eliminated by using final top coat of rubbed-effect varnish or lacquer. Operation No. 2 can be omitted if desired.

OPEN-GRAIN WOOD

2

Brushing or spraying, double-stain system.

1. NGR stain. Dry 20 min.
2. Paste wood filler. Dry as required.
3. First coat sanding sealer. One hr. dry.
4. Sand 6/0 garnet.
5. Second coat of sealer. Dry and sand.
6. Brush or spray wet coat of pigment wiping stain. Color should be a little darker than NGR. Let stand

- 2 to 10 min. as needed, then wipe with soft cloth, wiping clean or shading as desired. Dry 30 min.
7. Top coats of R&P varnish or lacquer.

NOTES: Double staining is recommended for off-color wood, also for shaded and antiqued effects. Shading can also be done—No. 6—by spraying NGR stain or shading stain; the wiping stain is best for brush system.

CLOSE-GRAIN WOOD

3

Lacquer system for birch, maple, etc.

1. Stain with NGR stain of desired color. Dry 20-30 min.
2. Spray lacquer sanding sealer. Dry 1 hr.
3. Sand 6/0 garnet, dry. Dust.
4. One to three coats of clear gloss lacquer, scuff-sanding between with 6/0 garnet. Let final coat dry overnight.
5. Rub (see rubbing schedules).

CLOSE-GRAIN WOOD

4

Brushing or spraying, double stain.

1. Brush or spray NGR stain. Dry 30 min. Sand lightly with 6/0.
2. Brush or spray pigment wiping stain of same color. Wipe clean or shade as desired. Dry 30 min.
3. Brush or spray sanding sealer. Dry 1 hr.
4. Sand 6/0 garnet, dry. Dust off.
5. Two coats of lacquer or one coat of R&P varnish.
6. Rub.

NOTES: For quality work, more coats of top material can be used to get a thicker film for thorough rubbing.

CLOSE-GRAIN WOOD

5

Spray only, double-stain system.

1. Spray pigment wiping stain. Wipe clean with rag. Dry 30 min.
2. Thin same stain 1 part to 3 parts naphtha. Spray-shade the work. Do not wipe. Dry 30 min.
3. Finish with sealer and top coats.

NOTES: This is similar to No. 4 except change in stain and application.



Skillsaw photo

SANDING Specifications

BARE WOOD—No. 1/2 or 1/0 for first sanding; 2/0 or 3/0 for second sanding; 5/0 or 6/0 for final. Best abrasive is garnet, open coated. Always use a sanding block of felt or rubber to build a level surface.

UNDERCOATS—Scuff lightly with 6/0 garnet finishing paper, dry. Back with hand only—don't use a sanding block.

WET SANDING—Waterproof garnet or silicon carbide. See rubbing schedules. Always use a felt or rubber backing block. Don't wet-sand one-coat work.

MACHINE SANDING—Belt: No. 1 for rough; 1/0 for finish; 3/0 or 4/0 for fine finish. Oscillating and magnetic: use same grits as for hand sanding.

CLOSE-GRAIN WOOD

6

Brush or spray, double stain. This gives a nice tone on maple, poplar, birch, pine, etc.

1. Brush or spray pigment wiping stain of desired color. Let dry until it starts to flat, then wipe with rag. Dry 30 min.
2. Brush or spray sanding sealer. Dry 1 hr.
3. Sand 6/0 garnet. Use 3/0 steel wool for moldings, carvings. Dust.
4. Optional. Second coat of sealer. Sand as before.
5. Pigment wiping stain, same as No. 1.
6. Varnish or lacquer top coats as desired.

NOTES: The second staining operation can be omitted if desired.

UNIFORMING SCHEDULE

7

For finishing open and close-grain wood in same piece.

1. Spray or brush NGR stain of desired color. Dry 30 min.
2. Apply paste wood filler to all open-grain wood and to end grain only of the close-grain wood. Wipe and let dry.
3. Brush or spray pigment wiping stain of matching color on close-grain wood only. Dry 30 min.
4. Brush or spray sanding sealer. Let dry 1 hr.
5. Sand 6/0 garnet.
6. Repeat 4 and 5.
7. Spray or brush pigment wiping stain over the entire piece, wiping and blending with rag as needed for color value. Dry 30 min.
7. Alternate. Spray shading stain or diluted wiping stain to uniform the wood. Do not wipe. Dry 30 min.
8. Top coats of varnish or lacquer.

UNIFORMING SCHEDULE

8

1. Apply NGR stain to light sapwood. Wipe with cloth dampened with alcohol to get color match. Dry 10 min.
2. Spray NGR stain but not wet; spray lightly on dark wood, heavy on light wood. Dry 30 min.
3. Spray lacquer wash coat over all.
4. Sand lightly with 6/0 garnet. Dust.
5. Fill all open-grain wood with paste wood filler.

MIX TRIX for Blonding

SPRAYING—Add white lacquer, 1 part, to clear lacquer, 5 parts. Dilute with thinner. Spray an even coat; do not wipe.

BRUSHING—Use flattening oil or glazing liquid as a base. Add small amount of fluid or tube oil color of desired color (zinc oxide for white). Wipe off when tacky.

BRUSHING—Mix boiled linseed oil, 1 part, turpentine, 1 part and japan drier, ½ part. Add white or other oil color to suit.

BRUSHING—Thin any white undercoat paint with equal volume of turpentine. Add spoonful of linseed oil per pint.

TINTS—Use regular white wiping stain. Tint with tube or fluid oil colors as desired.

6. Reduce same filler, 1 part filler to 2 parts naphtha. Apply to close-grain wood. Wipe off and let dry.
7. Spray wet coat sanding sealer. Dry 1 hr.
8. Optional. If further color toning or shading is required, spray shading stain or thin pigment wiping stain.
9. Top coats.



SURFACE COLORING SYSTEM

9

Spray system for select white wood.

1. Spray uniform coat of blond lacquer.
2. Spray two coats of water-white lacquer.

NOTES: This can be used for other colors—gray, cream, green, etc. A tan or gray may be used on dark woods.

SURFACE COLORING SYSTEM

10

Brush system for maple or birch.

1. Brush light-color pigment wiping stain (blond, platinum, pale birch, beachwood, wheat, etc.). Allow to dry until tacky and then wipe clean with soft cloth. Dry 30 min. to 2 hrs. as required.
2. Top coats of varnish.

2. Alternate: One coat of 2 lb. cut white shellac, followed by coat of paste wax.

NOTES: After the wood is colored, any top finish can be used. Water-white top coats are preferable since they retain pure tone of stain.

STAIN SYSTEM

11

Attractive light tones can be obtained on select white wood by stain. However, the wood cannot be made any lighter than its natural color.

1. Spray or brush diluted NGR stain of desired color.



Yellow, pink and green tones are practical. Dry 30 min.

2. Finish with Nos. 1, 2, 3 or 4.

BLEACH SYSTEM (open-grain wood) 12

A two-solution commercial bleach gives positive light tones on most woods and provides the proper ground-for attractive blond finishes.

1. Mix one part of No. 1 bleach with two parts No. 2. Apply with rubber sponge. Bleaching is complete in 1 hr. but work should dry 12 hrs.
2. Sand lightly with 6/0 garnet. Dust.
3. Apply paste wood filler. Wipe and dry.
4. Finish with sealer; sand; top coats; rub (see Schedule No. 1).

NOTES: Color in this system is obtained entirely from the filler. Use natural filler for lightest finish; tint natural filler with oil color or oil stain for other colors.

BLEACH SYSTEM (open-grain wood) 13

1. Bleach the wood.
2. Brush or spray diluted NGR stain. This can be pink, light green, yellow, etc.
3. Wash coat of shellac. Dry 30 min.
4. Apply filler. Use natural or tint with oil color to approximate color of stain.
5. Top coats.

NOTES: Color in this system is obtained from the stain. Always use a wash coat, No. 3, to prevent excessive darkening from filler oils.

BLEACH SYSTEM (close-grain wood) 14

1. Bleach the wood. Let dry.
2. Sand lightly 6/0 garnet. Dust.
3. Brush or spray desired color wiping stain, such as wheat, toast, sultan, platinum, champagne, etc. Let stand until stain begins to flat, then wipe clean with soft rag.
4. Brush or spray sanding sealer, preferably water-white. Dry 1 hr.
5. Sand 6/0 garnet, dry. Dust.
6. Spray two coats water-white lacquer or brush one coat clear synthetic.
7. Rub.

NOTES: After bleaching the wood, it can be finished by following any schedule for close-grain wood. Above is patterned after Schedule No. 6 with omission of second stain coat.

*various
materials*



STRAIGHT SHELLAC 15

1. Brush or spray 1-lb. cut white shellac. Dry 30 min. and scuff-sand with 6/0 garnet.
2. Second shellac coat, 2-lb. cut. Dry 2-3 hrs. and sand with 6/0 garnet.
3. Final shellac coat, 2 or 3-lb. cut. Allow 3 hrs. dry.

NOTES: For two-coat work, omit step 1.

SHELLAC AND WAX 16

1. Apply one or two coats of shellac according to Schedule No. 15.
2. Place a small quantity of paste wax inside double thickness of cheesecloth. Apply even coat. Dry 10-15 min.
3. Rub briskly with clean cheesecloth pad. Use rotary motion; finish with long strokes. Dry 1 hr. or more.
4. Repeat 2 and 3.

NOTES: Wax finish can also be used over lacquer or varnish. For a dull finish, wipe final wax coat with damp rag.

PENETRATING FLOOR SEALER 17

A simple in-the-wood finish of maximum durability. Low gloss.

1. Apply wet coat of penetrating floor sealer with brush or cloth. Let dry 15 min. and wipe off excess. Let dry 1 hr.
2. Buff the surface with No. 0 steel wool.
3. Apply second coat. Allow 10 min. for penetration. Wipe off excess. Dry overnight.
4. Buff with No. 0 steel wool.
5. Wax.

NOTES: Penetrating floor sealers are available in resin and resin-wax types. Exact application procedure varies—follow can directions. Most clear finishes can be colored with oil stain; some products are supplied ready-mixed in a variety of colors.

Reductions for STANDARD SHELLAC CUTS

OPERATION	CUT	3-LB. BASE		4-LB. BASE		5-LB. BASE	
		ALCOHOL	SHELLAC	ALCOHOL	SHELLAC	ALCOHOL	SHELLAC
WASH COAT.....	½ lb.	4	1	5	1	7	1
FIRST COAT.....	1 lb.	4	3	2	1	2	1
SECOND COAT.....	2 lb.	2	5	3	4	1	1
THIRD COAT.....	3 lb.	—	—	1	4	1	2
GENERAL USE.....	2½ lb.	1	5	1	2	2	3

Alcohol and shellac proportions are given in liquid parts. Example: You have 4-lb. cut shellac and want 1-lb. for first coat. From table, it can be seen this requires 2 parts alcohol and 1 part of 4-lb. cut shellac.

UREA-ALKYD (catalyst finish) 18

An extremely hard and durable finish for table and bar tops.

1. Stain with NGR stain if color is desired. Do not use pigmented stain as the adhesion is not good on undercoats of any kind.
2. Mix urea-alkyd synthetic with required amount of catalyst (about 1½ oz. per qt.), and apply with brush or spray. Dry 1 hr.
3. Sand 6/0 garnet. Dust.
4. Second coat urea-alkyd. Dry overnight.
5. Rub and polish.

NOTES: Some urea-alkyd finishes require baking. The above is for air-dry-or-bake type. Mixed solution must be used within 4 hrs.

SALAD-BOWL FINISH 19

A wax-resin finish for salad bowls and other turned woodenware which must resist water and various vegetable oils.

1. Spray impregnating salad-bowl sealer on wood. Dry 1 hr.
2. Scuff-sand, 6/0 garnet.
3. Spray one or two coats of salad-bowl lacquer.

NOTES: This is a lacquer system and must be sprayed. A brushing top coat is also available which makes a satisfactory finish in two coats without the impregnating sealer.

OIL FINISH 20

A fast oil finish for guns.

1. De-whisker the wood by wiping with a damp cloth and drying quickly. An electric heater is ideal for this purpose. After the wood is dry, cut the whiskers with 2/0 steel wool.
2. Fill with natural paste wood filler, mixed and wiped the same as for finishing walnut furniture. Dry 24 hrs.
3. Apply a first coat of boiled linseed oil, 4 parts, and spar varnish, 1 part. Rub with hand or cloth until dry. Let stand 48 hrs.
4. Apply boiled linseed oil and rub in as much as the wood is able to absorb. Polish with soft cloth until the wood is dry. Let stand a day or longer and repeat oiling until the finish is satisfactory.

NOTES: Use of filler and first coat of part varnish gives this kind of oil finish a quick build; as few as four coats of oil will bring up a good polish.



LIMED OAK 21

A popular novelty finish for oak or chestnut showing white pores on a gray ground.

1. Bleach the wood and stain with NGR silver-gray stain. On select white oak, bleaching can be omitted.
1. Alternate: Spray a coat of thin gray lacquer on the wood. This is an easier method than bleaching and equally good.
2. Wash coat of shellac or lacquer. This is required only if the wood has been stained; lacquer toner provides its own seal.
3. Fill with white paste wood filler. White wiping stain can also be used although it does not have the pore-leveling effect of filler.
4. Finish with top coats of clear shellac, water-white lacquer or water-white synthetic.
5. Wax (optional).

NOTES: Be sure wax is sanded perfectly smooth as even fine scratches will pick up the filler.

EBONIZED OAK 22

1. Spray diluted black lacquer on bare wood, just enough to get desired color.
2. Fill pores with white filler or white pigment wiping stain.
3. Top coats.

NOTES: This is same as limed oak but different-color ground; numerous color combinations are possible.

EBONY ON APPLE, PEAR OR MAPLE 23

1. Stain with hot, concentrated black NGR stain. Let dry and repeat.
2. Scuff-sand with 6/0 garnet.
3. One or two top coats of any clear finishing material.

Waxes for WAX FINISHING

HARD	Carnauba wax, 1 lb., ceresine wax, 1 lb., turpentine, 1 pt. Shred the waxes into a can and put the can in boiling water over a flame. After the wax melts, remove from heat and add the turpentine, which should be warmed in hot water.
MEDIUM HARD	White or yellow beeswax, 1 lb., turpentine, ½ pt. Mix by heating as above, or, shred wax in turpentine and let stand overnight.
COLORLED	Mix the turpentine in the above formulas with a small amount of the desired color in japan. Burnt umber or Van Dyke brown are satisfactory for browns; Venetian red makes a good red wax. Dry color can be used for ready-mixed wax; dry burnt umber makes a good brown wax, using about a teaspoonful of color per lb. of wax.
ANTIQUE WHITE	To 1 pt. of liquid wax, add about 1 oz. powdered rottenstone or dry sienna. Shred and melt paraffin wax. Thin as desired with a 50-50 mix of turpentine and naphtha. Color with a little dry zinc white.

3. Alternate: Finish with black polishing wax (see Schedule 16).

NOTES: See also Schedule No. 30.

CEDAR (Aromatic Red Cedar)

24

1. Spray 2-lb. cut pure white shellac. Dry 2 hrs.
2. Rub down with 2/0 steel wool.
3. Second coat of shellac, 3-lb. cut.
4. Sand 6/0 garnet or 3/0 steel wool.
5. Top coat of clear glass varnish.
5. Alternate: Top coat of 3-lb. cut shellac. Rub with 3/0 steel wool and then apply furniture wax.

NOTES: Schedule No. 15 can also be used. Shellac is essential as a first coat to seal the oil in cedar. When used for closets, box interiors, etc., the wood is not finished.

BEACHWOOD FIR

25

A subdued-grain finish for Douglas fir, white or yellow pine and similar woods.

1. Brush or spray clear plywood sealer. Let dry 4 hrs.
2. Scuff-sand with 6/0 garnet.
3. Brush coat of beachwood (light gray-green) stain, pigmented type. Let stain dry 5-10 min. Wipe clean with cheesecloth. Allow overnight dry.
4. Top coats of varnish or lacquer.

NOTES: Both the sealer and pigmented stain help to subdue the grain. After coat of plywood sealer, the wood can be finished with any schedule for close-grain woods. If NGR stain is to be used, reduce the priming sealer coat with 25 percent turpentine.

OLD-WORLD WALNUT

26

An open-pore finish suitable for walnut, mahogany or oak.

1. Stain the wood medium to dark brown, using pigment oil stain. Let stain dry 5 min. and then dry brush, wiping brush occasionally on cheesecloth to remove excess stain. Then, with clean cheesecloth pad, wipe centers of panels clean, blending stain to darken at edges. Let dry overnight. Do not sand.
2. Brush or spray sanding sealer. Dry 1 hr.
3. Scuff-sand with 6/0 garnet.
4. Top coat of lacquer or varnish.
5. Rub with 3/0 steel wool.
6. Wax with dark mineral wax.

NOTES: Feature of the above schedule is that all shading and color is obtained by dry-brushing and wiping the

single coat of pigment stain. A wash coat of shellac or plywood sealer can be used as a primer if desired and will facilitate smooth blending of stain coat. See also double-stain Schedule No. 6.

PICKLED PINE

27

1. Stain with NGR gray stain for pine.
2. Brush or spray sanding sealer or 2-lb. cut white shellac.
3. Brush over-all coat of white pigment wiping stain. This can be wiped clean or streak-glazed with a dry brush. Another treatment is to wipe the stain across the grain, producing a smoked effect.
4. Brush or spray 2-lb. cut white shellac or clear synthetic.
5. Optional. Rub down with 3/0 steel wool and apply coat of liquid wax.

NOTES: The true pickled finish is a gray finish with an overcoat of white, like the tone acquired by pickle vats. The finest work is done by first bleaching the wood; gray stain for pine then produces an even color.



LACQUER OR SYNTHETIC ENAMEL

28

1. Spray mist-coat lacquer enamel.
2. Sand back to bare wood with 6/0 garnet.
3. Apply two or more coats of enamel, scuff-sanding between with 6/0.

ENAMEL WITH UNDERCOAT

29

1. Wash coat of shellac. Dry 20 min.
1. Alternate: Mop, brush or spray plywood sealer thinned 1 part turpentine to 3 parts sealer. Dry 1 hr.
2. Scuff-sand 6/0 garnet. Dust.
3. Brush or spray undercoater. Spray lightly or brush out well. Dry as required.
4. Apply full wet coat of undercoater.

Patching METHODS

Defects which cannot be sanded out should be filled with plastic wood, cold-water putty or stick shellac. The putty is a powder which is mixed with water. Stick shellac is melted on a knife and the hot mixture run into the crack; some finishers burn-in with a soldering iron. In all cases, it is best to mask the defect with tape to avoid getting filler material on surrounding wood. Smooth the filler material level with the protecting tape, then strip the tape and sand to bare wood. Color matching for a clear finish may be done with the material itself, but the simplest system is to spot in the defect with pigment oil stain or shading stain applied with a small pencil brush.



5. Patch. Use water putty, lacquer putty, thickened undercoater or other suitable patching material.
6. Brush or spray first enamel coat. Scuff-sand with 6/0 garnet when dry.
7. Second enamel coat.
8. Optional, spray only. Finish coat of water-white clear lacquer, or regular clear with a small amount of enamel added.
9. Optional. Rub down with 8/0 (280) silicon carbide with water, followed by rubbing compound for high-gloss finish.

NOTES: This schedule applies generally to lacquer, synthetic or oil enamel. Undercoater in Step 4 may be tinted with the enamel color if desired, using 25 to 50 percent enamel. One coat of white undercoater and one coat of enamel will often make a satisfactory finish.

EBONY BLACK

30

A combined stain and enamel schedule for a permanent gloss black.

1. Stain with black NGR stain.
2. Fill pores with black paste wood filler. The filler used for red mahogany is satisfactory.
3. Two coats of black lacquer.
4. Two coats of water-white lacquer.
5. Rub and polish to high gloss.

NOTE: On close-grain wood, the filling operation is not required.



DULL SATIN

31

1. Rub with 3/0 steel wool.
2. Polish with dry cloth.

NOTE: This rub will cut gloss quickly but will not level the surface.

SATIN

32

1. Rub with FF pumice and water, using felt pad. Flush with water.
2. Rub with rottenstone and water or rottenstone and rubbing oil.

3. Wax or furniture polish, if desired.

NOTES: When finish consists of sealer, first varnish coat and second varnish coat, the second coat can be rubbed with 320-grit wet-or-dry paper with water lubricant. The idea is to build a level surface before the top coat is applied.

SATIN

33

1. Rub with 280 or 320-grit wet-or-dry paper with soapy water lubricant. Soap can also be applied to paper to prevent gumming. Use felt backing block to build level surface.
2. Wipe surface with cloth and continue rubbing with 3/0 or 4/0 steel wool.
3. Apply coat of liquid wax and rub dry.

NOTES: This schedule is especially good for lacquer rubbing, either clear or enamel.

SATIN-TO-POLISH

34

1. Rub with ready-mixed rubbing compound. Use bur-lap pad.
2. Clean up and wax.

NOTES: This produces a satin-to-polish finish depending on the grade of rubbing compound used. This is as fast as a steel wool rub and has more gloss. About 10 strokes bring up a satiny polish.

HIGH POLISH

35

1. Follow any satin schedule. Let dry 12 to 24 hrs.
2. Rub with polishing oil.
3. Remove excess oil with rag dampened with alcohol. Polish with dry cloth.

HIGH POLISH

36

1. Follow any satin schedule.
2. Rub with a polishing compound or automobile polish.

NOTES: Numerous rubbing and polishing compounds are available.

FRENCH POLISH (high gloss)

37

1. Apply any finish with lacquer, shellac, enamel or varnish.
2. Sand with 6/0 garnet. Dust.
3. Dilute ready-mixed French polish with about 25 percent of special solvent provided. Apply mixture to cloth pad and flatten pad on palm of hand. Pad the work with circular strokes and then finish with the grain.

NOTES: Use only improved French polish such as Quatsale, which requires no lubricant.

Rubbing MATERIALS

RUBBING FELT—Soft, pressed felt, 3 x 5 in., and at least 1/2 in. thick. Several smaller pieces.

ABRASIVE PAPER—6/0 (220-grit), 8/0 (280) and 9/0 (320) wet-or-dry silicon carbide.

PUMICE—No. 1 for coarse rubbing. Nos. FF or FFF for fine rubbing.

ROTTENSTONE—For fine rubbing.

RUBBING OIL—Lubricant for rubbing. Purchased ready-mixed. Paraffin oil, crude petroleum or light motor oil thinned with benzene can be used.

NAPHTHA—For cleaning up rubbing slush.

POLISHING OIL—Purchased ready-mixed. A home-

made mix can be made with half-and-half olive oil and alcohol. Standard household furniture polishes can be used.

RUBBING COMPOUND—Ready-mixed paste or liquid abrasive. Various grades of fineness.

WHITE SOAP—Any white soap. Used to keep fine abrasive paper from loading.

LACQUER POLISH—For cleaning up rubbing compound haze. A large number of ready-mixed products available. Automobile polish can be used.

ALCOHOL—Used to spirit-off polishing oil. Add water as desired to reduce strength.



Blond Finishes

You can glorify your furniture in the beautiful and modern blond finishes with either a spray gun or a brush. The table below gives typical blond schedules

BLOND-FINISH SCHEDULES

FINISH

APPLICATION

Ambered walnut	Bleach. Stain with amber stain. Apply sealer coat of thin lacquer. Fill with natural filler. Finish with clear lacquer.
Old-World walnut	Bleach. Seal. Fill with natural filler lightly tinted with burnt umber. Seal. Shade with brown wiping stain. Finish with clear lacquer.
Honeytone maple or birch	Tane with blond toner, using 1 part white lacquer to 4 parts clear, flat lacquer. Finish with water-white lacquer.
Pickled pine	Bleach. Stain with gray stain for pine. Finish with water-white lacquer or clear varnish.
Limed oak	Bleach. Seal. Fill pores with white paste wood filler. Finish with water-white lacquer.
Harvest-wheat mahogany	Bleaching will give required wheat color. Fill with natural filler lightly tinted with raw-sienna color in oil. Finish with lacquer.
Tweed mahogany	Bleach. Seal. Fill pores with red paste wood filler. Finish with water-white lacquer or clear varnish.
Heather mahogany	Bleach. Seal. Fill pores with white paste wood filler. Finish with water-white lacquer or clear varnish.

WOOD FINISHING



Bleaching

WITH the increased use of small spray-painting outfits, and the many new types of stains, lacquers and synthetics readily available, the craftsman can duplicate the finest finishes seen on manufactured furniture. Beautiful blond tones in ambered walnut, honeytone maple and harvest-wheat mahogany, interesting novelty effects such as limed oak, bone white and pickled pine, as well as smart contemporary finishes

Photo courtesy
American Furniture Mart



such as antique maple and natural birch, all are within his scope. The man with the brush is not out of the picture either, as most of these finishes can be applied nearly as well by hand brushing.

Bleaching: One of the basic processes for many of the newer blond finishes is bleaching, which means the removal of the natural wood color with various chemical solutions. Of several different types of bleaches, the two-solution bleach consisting of concentrated hydrogen peroxide and an alkaline solution is generally considered most effective—it will produce nearly white tones on walnut and mahogany with one application. Application of the two-solution bleach can be done by applying the solutions consecutively or premixing them immediately before using. Most finishers prefer the premix method. The mixed solution is corrosive and should be worked only from a glass or porcelain container; the finisher should be wearing rubber gloves and a rubber





Wheat Color on Birch

apron, Fig. 1. Splashes on the skin or clothing will do no harm if washed off immediately with water. The bleaching action will be complete in about an hour, and can be repeated if desired. Application of No. 2 solution alone in a second coat is effective. A light sponging with water after the bleach has become surface-dry will assure removal of any residue which might affect the finish. The work itself should dry for at least 24 hours before proceeding with the finish.

The bleach will raise the grain of the wood so that light sanding is needed to restore the surface. Many finishers make use of a trick also practiced in the application of water stains. The work is first wet with water or a thin glue sizing coat and then sanded smooth. When dry it will show less grain-raising when the bleach is applied. The idea, of course, is that too much sanding on a bleached surface may expose dark wood. In order to determine the grain-raising tendency and also to check the color of the wood, it is advisable to make a test strip, Fig. 2, before going ahead with actual work.

Toning: Toning, Fig. 4, is the second basic process. This calls for the spraying of a semitransparent undercoat to lighten the wood rather than the more expensive and longer bleaching schedule. It is not too successful on dark woods such as walnut or mahogany, but very good on naturally light-colored woods such as birch and maple. Toners can be purchased or made.

For spray application a good toner can be made by adding white lacquer, 1 part, to clear flat lacquer, 4 or 5 parts, as in Fig. 3. This mixture is sprayed directly on the bare wood. The semitransparent nature of the toner does not obscure the grain, but at the same time it makes the wood much lighter. On oak and mahogany, the toner should be made with tan lacquer instead of white. In fact, there is no limitation on color effects. If you are brushing, any pigment wiping stain can be used, applying by brush and wiping off with a clean rag after about 5 min. setting time. Some products sold for this purpose come in white only, but can be tinted any desired color with tube or fluid oil colors. Pigment stains applied by clean wiping do not materially lighten the wood but are excellent for wheat, suntan, platinum and other light colors applied to light-color wood. Brush blending a heavier coat is often used to lighten dark streaks in the wood.

Honeytone maple: This attractive effect of blond wood, shown in Fig. 5, can be worked on white maple or birch by toning. Spray a thin coat of white toner directly on the bare wood after sanding. Finish with two coats of water-white lacquer. This is almost as clear as water and does not have the amber color of ordinary clear lacquer or varnish. It should be used on all extremely light finishes. Water-white synthetics substitute perfectly if you are brushing, and, as previously mentioned, a wipe-off stain can be substituted for the sprayed lacquer toner. Some concepts of "honeytone" run to a stronger yellow, and this effect can be obtained by tinting the white lacquer or the white wiping stain with a small amount of light or medium chrome-yellow oil color.

It is worth noting that most of the modern named finishes—wheat, champagne, suntan, desert dust, honeytone, platinum, etc.—are derived from a color similarity. Actually there is no fixed standard "honeytone," and what you buy from one supplier may be a different shade than another. Also, it is worth repeating that there is nothing to keep the finisher from striking out on his own—all it takes is a touch of oil color and you can run the rainbow.

Ambered walnut: The light amber finish so popular on walnut can only be obtained by using a commercial bleaching solution. Toning, if carried to a stage of light coloring, will completely kill the grain of the wood, giving the piece a painted appearance. Start by applying the bleach. Let it dry on the wood overnight and then sand lightly with 6/0 sandpaper. Dust the work, and stain it with a non-grain-raising, quick-drying stain. This should be light amber color and should be



Limed Oak



Midnight Oak

Delta photo

thinned as much as needed with the required thinner until the tone is just a shade darker than the bleached color of the wood. Seal the stain with a wash coat of shellac to prevent further darkening of the wood by the oil in the filler. Apply natural (transparent) filler. Let dry thoroughly. Finish the schedule by applying two or three coats of clear gloss lacquer, rubbing the last coat to a satin finish.

Limed oak: To produce limed oak, Fig. 6, bleach the work with a commercial bleach. Stain or leave the wood in its natural bleached color as you desire. Apply a wash coat of water-white lacquer. Fill the pores of the wood with white filler. This can be obtained ready-mixed or made by adding zinc-white oil color to natural filler. Use only water-white lacquer as a top coat over this finish—ordinary clear lacquer will spoil the color.

Silver oak: This is similar to limed oak but is obtained by the toning method. Mix light gray lacquer, 1 part, with lacquer thinner, 3 parts, and spray directly on the bare wood until an even color is obtained. Fill the pores of the wood with white filler, Fig. 8, and finish with water-white lacquer. Many novel effects can be obtained in this manner by using different toners and fillers. Midnight oak, Fig. 7, is simply a thin black lacquer for the ground color, filled with white paste filler.

Other blond finishes: All other blond finishes feature the same application of the basic processes already described. Mahogany, bleached and filled with white filler, is known as "heather mahogany." When filled with red filler (made by adding red oil color to natural filler) the delightful pink tone is called "tweed." Bleached mahogany



Silver Oak

The use of a filler to plug the pores of the wood is an important step in obtaining good results with all oak finishes. Red filler is used for obtaining the special "heather" and "tweed" mahogany effects



Champagne

Heywood-Wakefield



SPRAYING BONE-WHITE LACQUER COAT

APPLYING WARM-BROWN WIPING STAIN

WIPING STAIN WITH SOFT RAG

with a natural filler is one of the most attractive in the blond mahogany group and is variously known as "harvest-wheat mahogany," "bronze mahogany," etc. The popular wheat color is also used extensively on birch and maple, the color being obtained by a lacquer toner or with wheat-color pigment wiping stain. Champagne, Fig. 9, is a pleasing light brown with a pinkish cast, readily worked on maple or birch with pigment wiping stain or toner. The exact schedule for champagne as used by Heywood-Wakefield calls for staining with pigment stain; spray a coat of water-white sealer; sand; spray coat of clear synthetic (Dulux); rub and wax. Apart from the fact that commercial concerns commonly use dip methods for pigment staining and make extensive use of baking ovens for rapid drying, you can duplicate this and other finishes exactly with ordinary methods. A double-stain coat with brush or spray is about equal to the single-dip application.

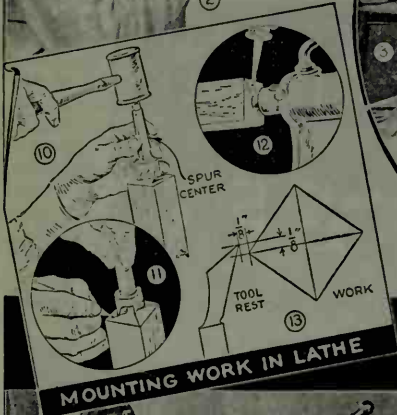
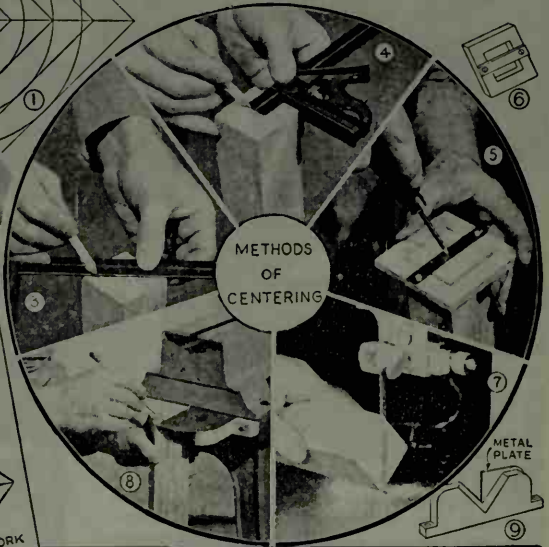
Bone white: Bone white, Figs. 10, 11 and 12, is a popular enamel finish. Start by giving the work a coat of bone-white enamel. This is purchased ready-mixed and is simply an off-tone shade of white which the finisher can mix himself, if desired, by adding a little black or brown lacquer to white lacquer. Next, spray or brush a coat of warm brown wiping stain. Wiping stain is ordinary oil pigment stain, but somewhat more concentrated. Before the stain dries, start to wipe it off with a soft rag. Do a rather thorough job, leaving just a trace of stain in recesses and corners. When the stain is dry, finish with top coats of clear lacquer.

Antique maple: The popular color for maple pieces in Early American styling is a red-orange, usually sold under the label,

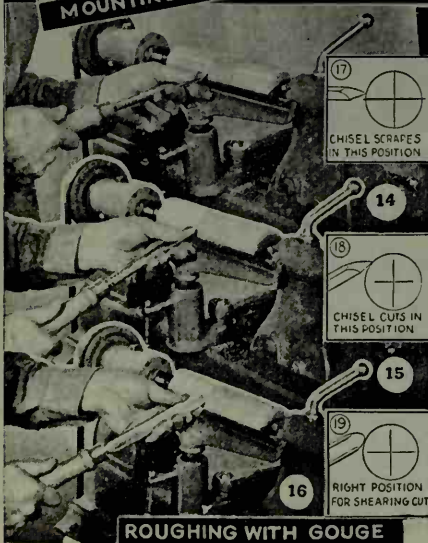


"antique maple," Fig. 13. After staining, the work should be coated with orange shellac or clear lacquer. Staining alone seldom gives the mellow aged appearance so essentially a part of this finish, making it necessary to apply a second coat of stain to obtain highlights. This second stain coat is a warm brown wiping stain, the same as used in the bone-white finish. It is sprayed or brushed on the work and then wiped off rather cleanly. Even on areas wiped perfectly clean with a dry cloth, a portion of the stain will remain on the wood to give a shaded effect to the finish. Extra clean highlights are obtained by wiping the stain with a rag moistened with benzine. After the wiping stain has dried, the work can be finished with clear lacquer or varnish.

WOOD LATHES



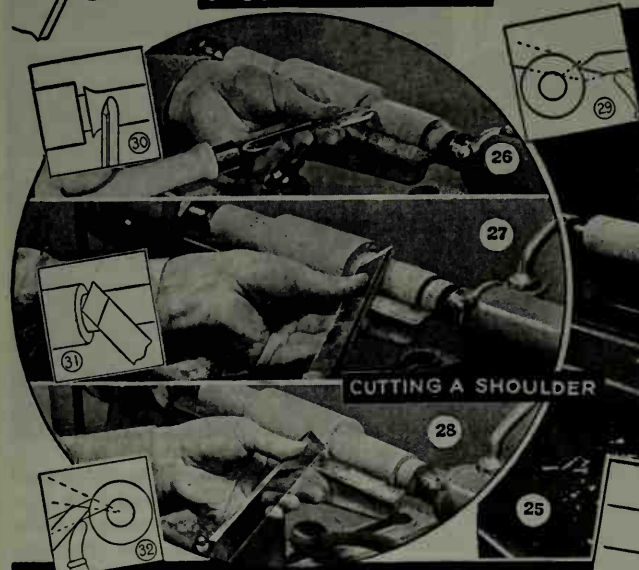
SPINDLE



SPINDLE turning between centers is the groundwork for all wood lathe operations. The first step in making a spindle turning is centering the stock. The latter should be square, or nearly so, and the center at either end located and marked by any of the methods shown in Figs. 1 to 9 inclusive. After centering, the spur center is driven into one end of the work with a mallet, as shown in Fig. 10. Never drive the work onto the spur center in the lathe. Since the spurs of the center may not be exactly alike, nick one of them with a file and make a pencil mark opposite the nicked spur as in Fig. 11. Thus marked, the work may be removed from the lathe at any time and accurately re-centered when it is again mounted for turning. Mounting the work between centers done by advancing the tailstock cup cer



SMOOTHING WITH SKEW



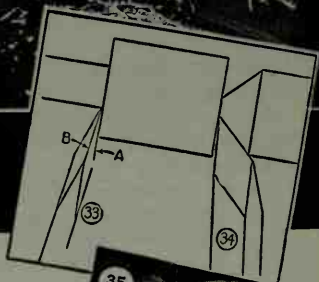
CUTTING A SHOULDER



TURNING

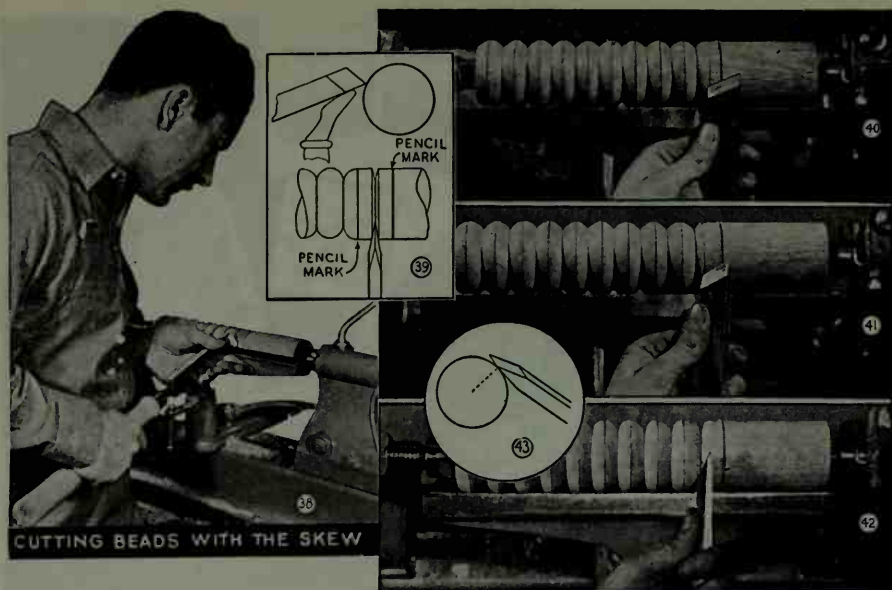
into the work while the latter is being turned by hand. When the stock binds, the tailstock is backed off about one-quarter turn and locked. Apply a few drops of oil, as in Fig. 12, to prevent the wood from burning the cup center. Many turners use tallow or wax for lubricant, since this does not stain the wood. Fig. 13 shows the relative position of the tool rest with the axis of the work. As the square is turned into round, the rest is moved up by stages. About $\frac{1}{8}$ in. above the axis and the same distance from the surface, is a fair rule to follow, although there are variations, of course.

The first turning operation is the "roughing cut," made with the gouge. Figs. 16 and 19 show the proper position—the bevel should be tangent to the work, and the tool rolled on its side. Figs. 14 and 17 show the wrong position, resulting in a scraping action. The position shown in Figs. 15 and 18 permits the chisel to cut, but lack



VEE GROOVES

36



of clearance prevents the easy, shearing cut possible with the correct position, Fig. 16. The final smoothing of the cylinder after roughing is done with the large skew chisel, the correct position being shown in Fig. 20, with the cut moving toward the right. By reversing the position of the chisel, the cut can be carried equally well to the left. The edge of the chisel should be tangent to the work, Fig. 21, and should contact the surface at the point indicated. The secret of successful smoothing with the skew lies in using the bevel of the chisel as a fulcrum, Fig. 22. If the handle is too low, the edge will not cut, Fig. 23, while if the handle is too high, Fig. 24, the edge will not be supported and will have a tendency to draw into the wood.

Next, the various diameters of the turning are set off with the parting tool, Fig. 25. The calipers are set slightly oversize, and are held against the revolving work until they slip over the stock remaining at the bottom of the groove. This is a scraping cut, which is the safest. A better action is obtained if the lower edge of the chisel is kept approximately tangent to the cylinder, Fig. 29, but the tool is a bit more tricky to handle.

Following the parting tool, Figs. 26, 27, and 28 picture the cutting of a shoulder. In

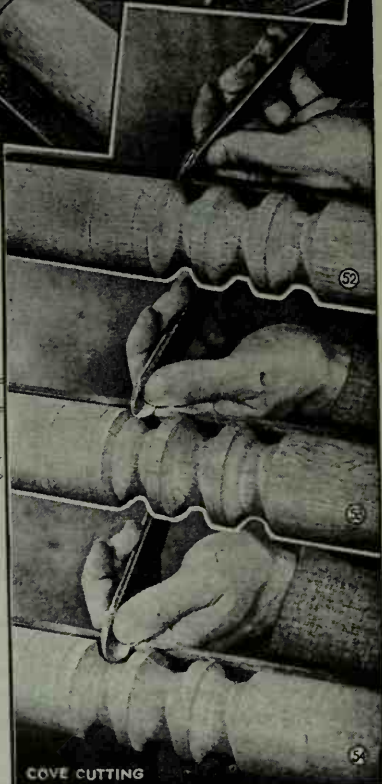
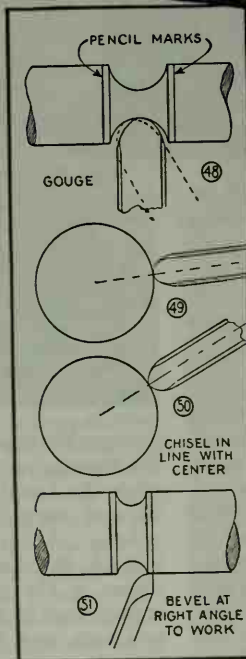
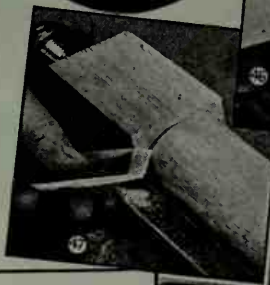
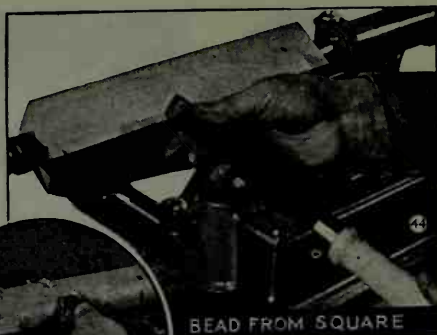
the first operation, the waste is cleared away with the gouge, Figs. 26 and 30. The heel of the skew is then used to smooth the new surface squarely into the shoulder, Figs. 27 and 31, while the toe of the skew is used to dress the shoulder smooth and to exact size, Figs. 28 and 32. When using the skew in this last position, the cutting edge should at all times point toward the center of the work, Fig. 32. A still more important point in making this cut is shown in Fig. 33. Here the line "B" is the cutting edge of the chisel; line "A" is the bevel. Notice particularly that the bevel A is exactly parallel with the cut surface, while the cutting edge is slightly turned away. The same general technique used in cutting a shoulder can be used for clearance cuts or for making vee grooves, as in Fig. 34. Vee grooves can also be made with the heel of the skew, as in Fig. 37. From this position, the handle of the chisel is raised to hinge the cutting edge into the wood. The same rule about not engaging the full cutting edge applies. Slightly exaggerated, Fig. 35 shows how the edge of the chisel is almost, but not quite, parallel with the surface being cut. This is correct. Fig. 36 shows the edge of the chisel exactly parallel with the cut surface, which is incorrect. When the edge is thus engaged, a

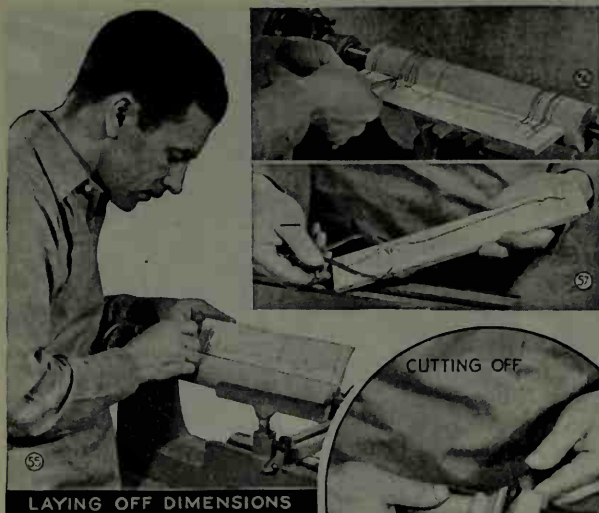
"run" invariably results. Keep in mind that a point, either toe or heel, cannot run. It is only when the whole edge or a considerable part of it is engaged, as in Fig. 36, that runs occur.

Figs. 38 to 42 inclusive show successive stages in cutting a bead. The center of the depression should be marked first by running in with the toe of the skew, as shown in Figs. 38 and 39. Starting the cut from the position shown in Fig. 40, the chisel is slowly rolled to the left and simultaneously the handle is raised to keep the bevel in contact with the wood. The essential point in cutting a bead is shown in Fig. 43—the bevel of the chisel should be tangent to the work. In this position, the chisel cannot run.

Quite often, a bead must be cut from a square portion of the turning. When this is done, the work is first nicked with the point of the skew, Fig. 44. After nicking, the round portion of the turning can be roughed out without any danger of splintering the square part, Fig. 45. After the round portion is turned down to a true cylinder—this is easily checked by placing the chisel flat on the revolving work to detect any "hammering" action, as shown in Fig. 46—the bead itself can be cut. This can be done in the same manner as previously described, although many turners prefer the simpler scraping operation with the toe of the skew, Fig. 47.

Figs. 51 and 52 show the start of the difficult cove cut, and Figs. 53 and 54 show the slight rolling action of the gouge as the cut progresses. Pencil marks are first made to indicate the edges of the cut and the excess wood inside the marks is removed with the gouge, using a scraping position,





sume the same relative position throughout the operation.

When the basic cuts have been mastered the turner can do any ordinary spindle turning. The essential points are illustrated in Figs. 55 to 60 inclusive. The first step after smoothing the cylinder is to mark off the dimensions. This is best done with a layout board.

A layout board is simply a thin piece of wood on which is drawn a full-size half section of the proposed turning. Placing the board against the cylinder, the turner

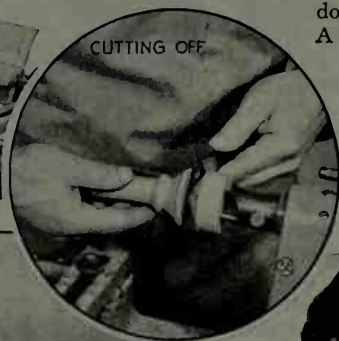
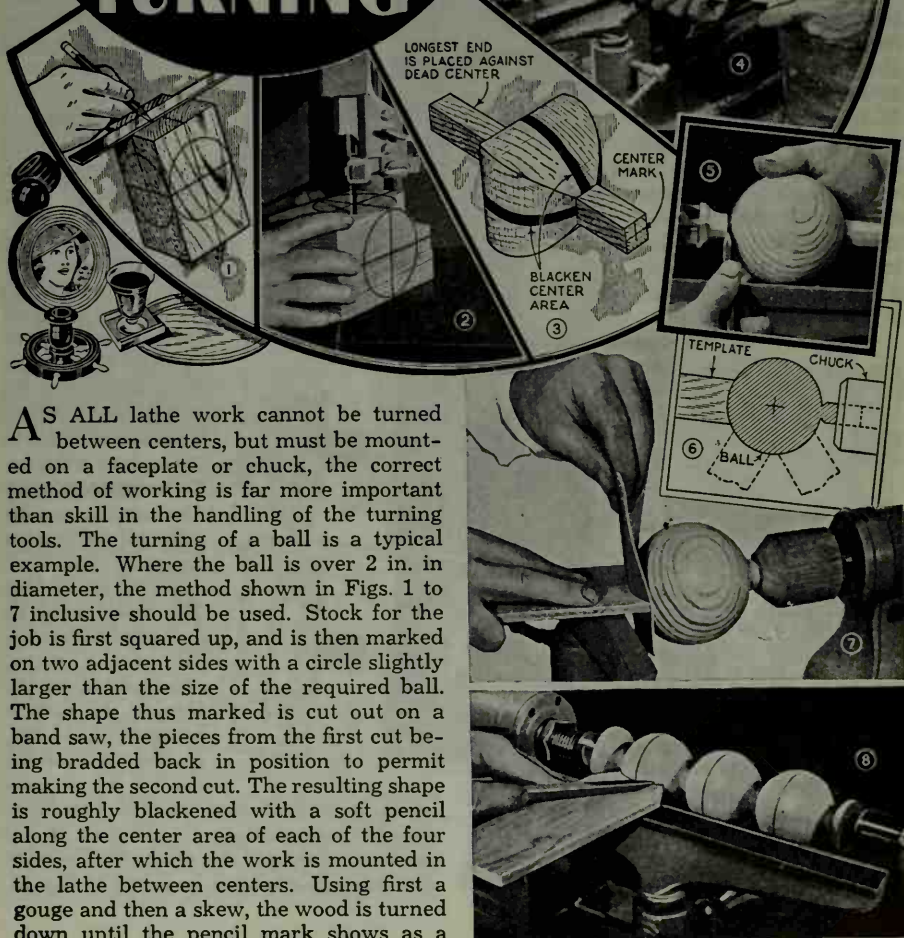


Fig. 48. The entire cut can, of course, be made in this manner, the practice being quite common even among experienced turners. To proceed with the rolling cut, the first essential point is that the gouge must point to the exact center of the work. Whether the tool rest is low, Fig. 49, or high, Fig. 50, this same rule applies. The reason for this is simple: The exact point of the gouge which is thus engaged cannot run. The second essential point is shown in Fig. 51—the bevel of the gouge must form an exact right angle to the surface of the work. From this position the gouge is rolled into the cove, making one-half of the cut in one operation, and the opposite side of the cut in a second operation which is a reverse of the first. It's important that the tool handle be swung through an arc simultaneously, so that the bevel will as-

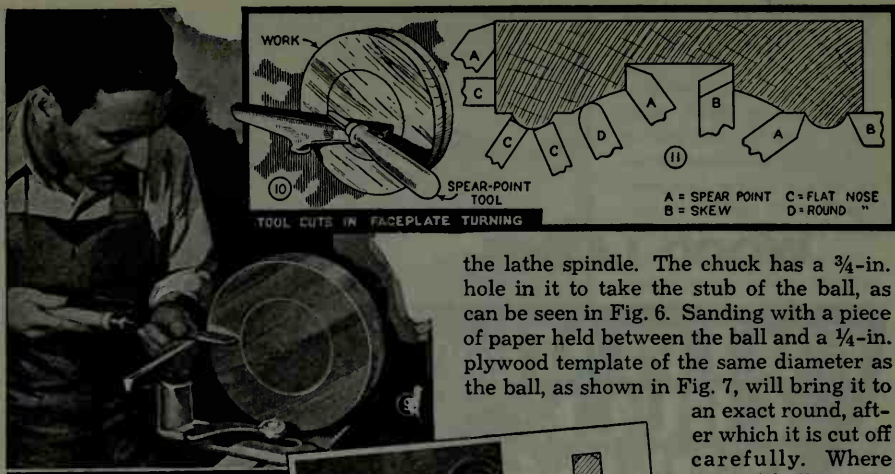
can quickly mark the various points along the turning, as in Fig. 55. Many turners place the board flat on the tool rest, Fig. 56, and mark the work while it is revolving. After marking the required lengths, the diameters are picked off, as shown in Fig. 57, and the caliper setting is then used in making the initial parting-tool cuts, and then the various forming cuts are made.

WOOD LATHES

FACEPLATE *and* CHUCK TURNING



AS ALL lathe work cannot be turned between centers, but must be mounted on a faceplate or chuck, the correct method of working is far more important than skill in the handling of the turning tools. The turning of a ball is a typical example. Where the ball is over 2 in. in diameter, the method shown in Figs. 1 to 7 inclusive should be used. Stock for the job is first squared up, and is then marked on two adjacent sides with a circle slightly larger than the size of the required ball. The shape thus marked is cut out on a band saw, the pieces from the first cut being bradded back in position to permit making the second cut. The resulting shape is roughly blackened with a soft pencil along the center area of each of the four sides, after which the work is mounted in the lathe between centers. Using first a gouge and then a skew, the wood is turned down until the pencil mark shows as a



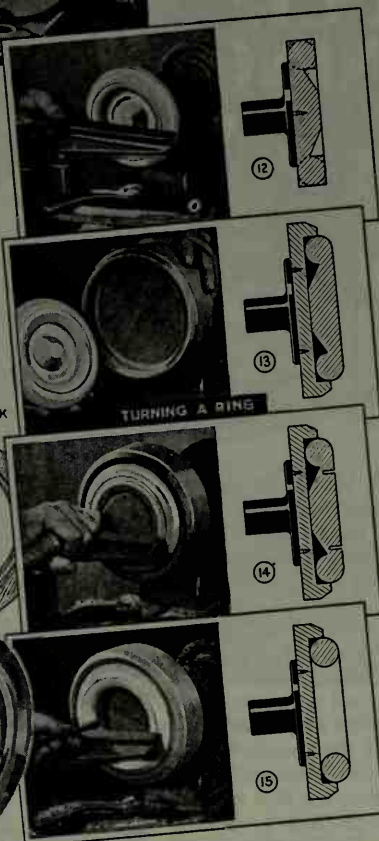
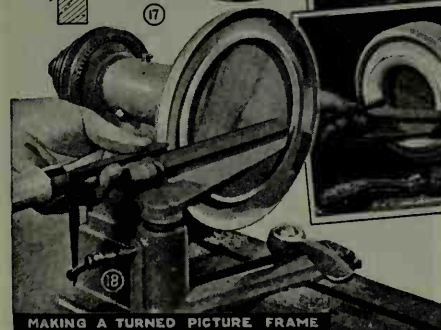
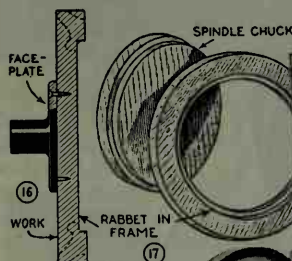
faint line, as in Fig. 4. Next, carefully capiler and turn the narrow neck at the dead-center end to $\frac{3}{4}$ -in. diameter. The ball can now be cut off at the live end, as in Fig. 5. A wood chuck is made up, and is mounted on the single-screw center, or, better, fitted by means of a set screw to the end of

the lathe spindle. The chuck has a $\frac{3}{4}$ -in. hole in it to take the stub of the ball, as can be seen in Fig. 6. Sanding with a piece of paper held between the ball and a $\frac{1}{4}$ -in. plywood template of the same diameter as the ball, as shown in Fig. 7, will bring it to

an exact round, after which it is cut off carefully. Where several balls are to be made, they can be turned in line, as shown in Fig. 8. Notice that a spear-point tool is worked directly over a wooden template to obtain the proper shape at the center of each ball. After the center is perfect, the balls can be cut apart and finished in a cup chuck, shown in Figs. 33, 35 and 36.

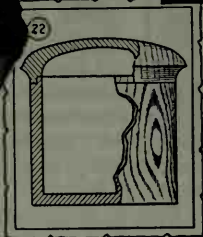
Figs. 9 to 11 show various cuts used in faceplate turning. Differing from spindle turning, practically all cutting on faceplate work is done by scraping. The chisel must be in line with the center of the work, especially when the face of the disk is being worked. Fig. 9 shows one of the most common

methods of surfacing, in which a skew chisel is advanced across the face of the work. Surfacing is also done with the edge of a spear-point chisel, as shown in Fig. 10,





TURNING A NAPKIN RING ON A SPINDLE CHUCK



back of the frame is cut first, this being done while the work is mounted on a faceplate, as shown in Fig. 16. The rim is then used to hold the work on a spindle chuck, as shown in Figs. 17 and 18.

The turning of napkin rings and similar hollow cylinders offers another example in the use of the spindle chuck. As shown in Fig. 19, the napkin ring is first finished on the outside and bored halfway through, this being done while the work is mounted on the single-screw center. A suitable spindle chuck is then made up to fit tightly inside the ring, as shown in Fig. 20. Mounted on this spindle chuck, the opposite end of the ring can be turned out, Fig. 21.

Boxes and similar turnings whose bottoms are too thin to take screws must be mounted on backing blocks. In the example, shown in



TURNING A BOX

SPEAR POINT

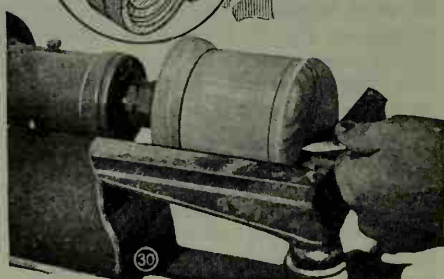
CHISEL

BACKING

LID

and also can be done with a flat-nose chisel.

A job that involves both faceplate and chuck work is the turning of a ring, as shown in Figs. 12 to 15. The work is first fastened to a suitable faceplate to permit the outer portion of the ring to be turned, after which the partly finished ring is put in a recessed chuck. This must be turned carefully so that the ring will be a "press fit." A parting tool now is used to cut away the center of the ring. Templates should be used frequently to check the progress of the work. Turned picture frames and trays are worked in much the same manner as a ring. The recess in the





USEFUL LATHE CHUCKS

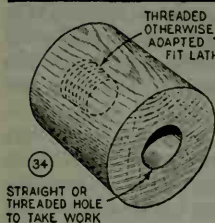


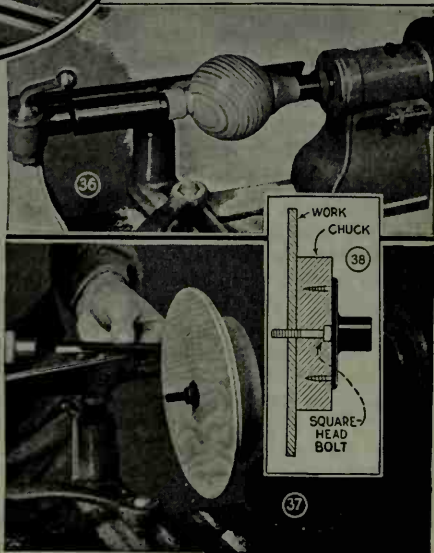
Fig. 22, the stock for the body of the box is glued to a soft-wood backing block, Fig. 24. A piece of paper must be placed between the joints so that the work can be separated easily from the block. The lid for the box is mounted in the same manner on a second block, this, in turn, being fastened to a suitable lathe faceplate.

The inside of the lid is turned first, Fig. 23, after which the inside of the box is turned out, Fig. 27. If you have a slide rest, by all means use it for deep boring like this. The center can be turned out equally well, however, with a spear-point chisel or skew, as shown in Fig. 26. In either case, it is usually simpler to start the hole by drilling, as in Fig. 25. The inside of both lid and box completed, the lid can be tested on the box, as indicated in Fig. 28. A tight fit is essential. The lid can now be separated from its backing block. This is

best done with a flat-nose chisel, Fig. 29. The lid is now mounted on the box and the outside of both lid and box turned, Fig. 30. Keep the work on the faceplate until it is polished or otherwise finished, then sand the joint between the box and the lid lightly, and remove from the backing block.

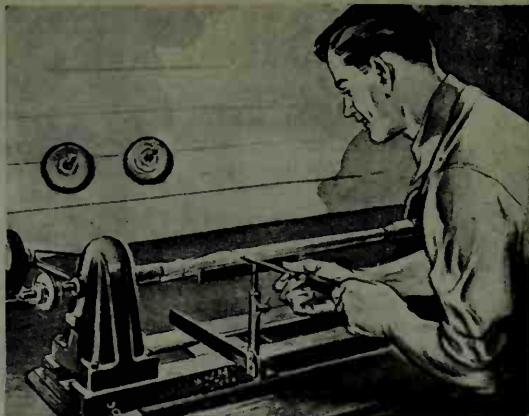
Chucks, other than those already mentioned, are frequently useful. A common type is shown in Fig. 31 and in 32. Fig. 34 shows a similar chuck, but without the expansive feature. The hole can be tapered or straight as desired. This kind of chuck is ideal for turning wood goblets and similar work, as shown in Fig. 33.

Figs. 35 and 36 show a cup chuck, which is often used in turning balls. Figs. 37 and 38 show a useful chuck for turning disks and other work having a central hole. Its construction and use are apparent from the sketch and photo.

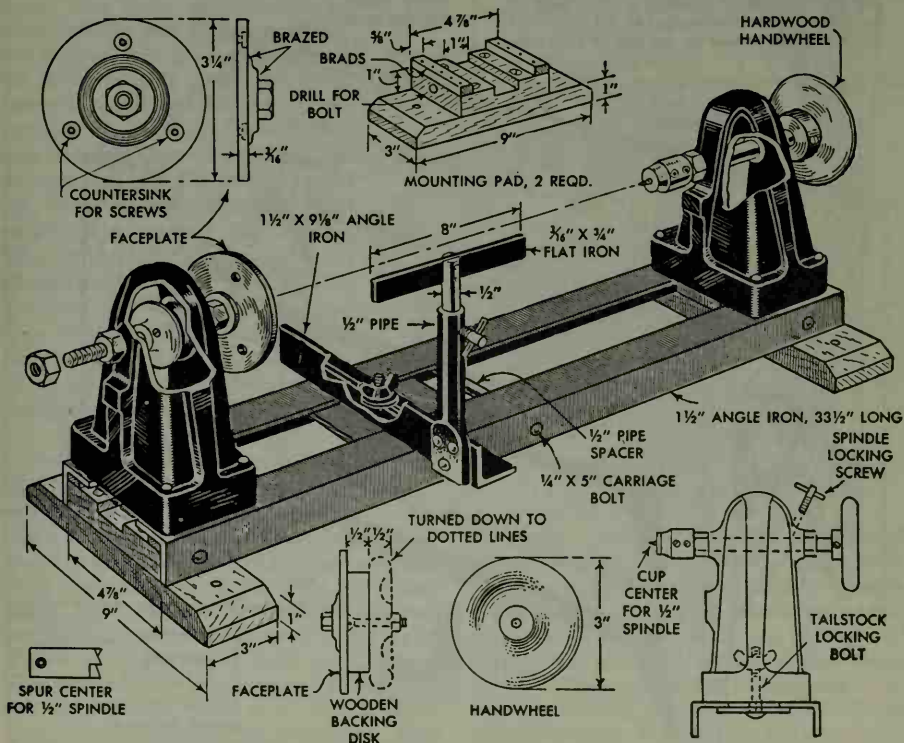


WOOD LATHES

IF YOU have only occasional use for a wood-turning lathe in your home shop, here's a way to make a serviceable one at minimum cost. Two ordinary bench-type polishing heads form the head and tail stocks. As dimensioned below, the lathe takes 22 in. between centers and provides a 12-in. swing over the bed. The distance between centers can be increased to 29 in., the standard table-leg length, by making the angle-iron bed members $40\frac{1}{2}$ in. long. The bed members are bolted to hardwood mounting pads, the bolts passing lengthwise through the spacing blocks and through the flanges of each angle. A pipe spacer is used at the center to maintain alignment of the bed members. No changes in the polishing heads are necessary except drilling and tapping a hole in one



bearing of the tailstock to provide for a spindle locking screw, and filing a flat on one threaded end of the each spindle so that the setscrews in the centers do not damage the spindle threads. Both the headstock and tailstock are attached to the bed with bolts and wing nuts, the bolts passing through flat plates which bear against the angle-iron flanges. A faceplate, handwheel and tool rest are easily improvised.

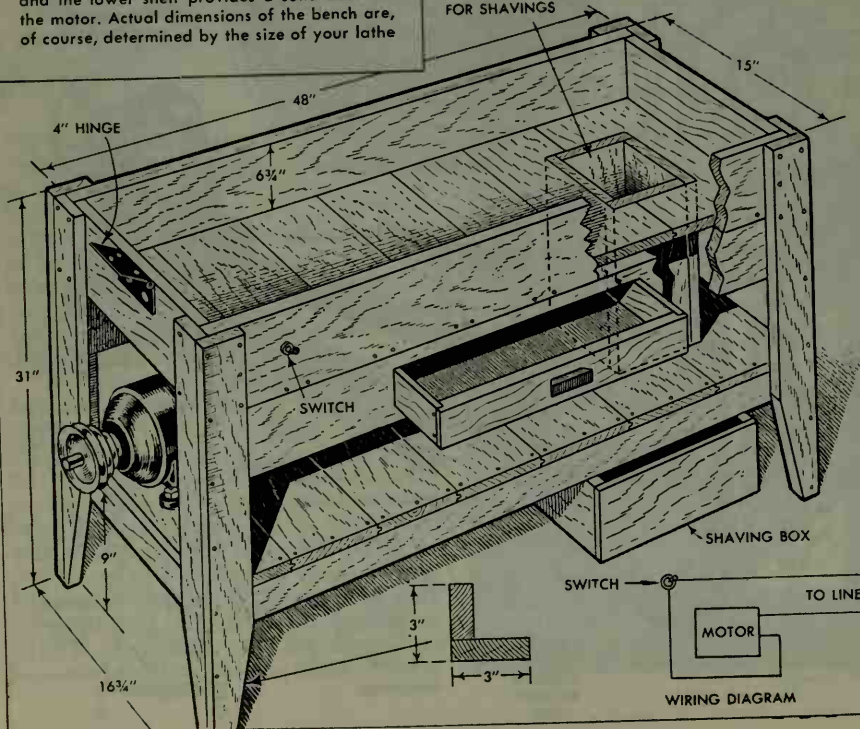


WOOD LATHES



A deep tray built into the top of this unusual lathe bench catches 90 percent of the chips from the average wood-turning operations. Lathe bed is hinged at the headstock end so that it can be propped up and accumulated shavings swept into a chute from which they are deposited in a box located beneath the bench. There also is a drawer for lathe tools and the lower shelf provides a solid base for the motor. Actual dimensions of the bench are, of course, determined by the size of your lathe

6" X 6" CHUTE
FOR SHAVINGS

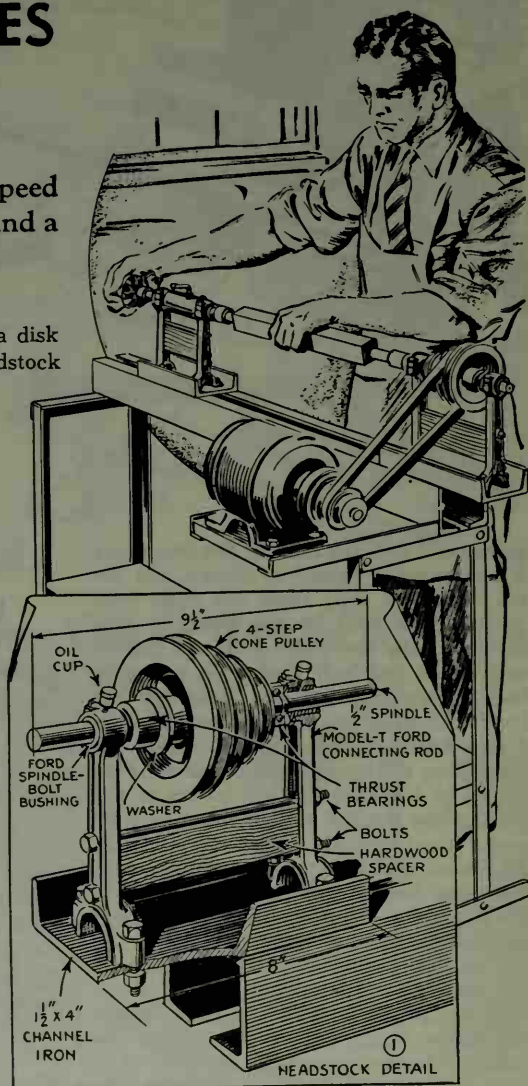


WOOD LATHES

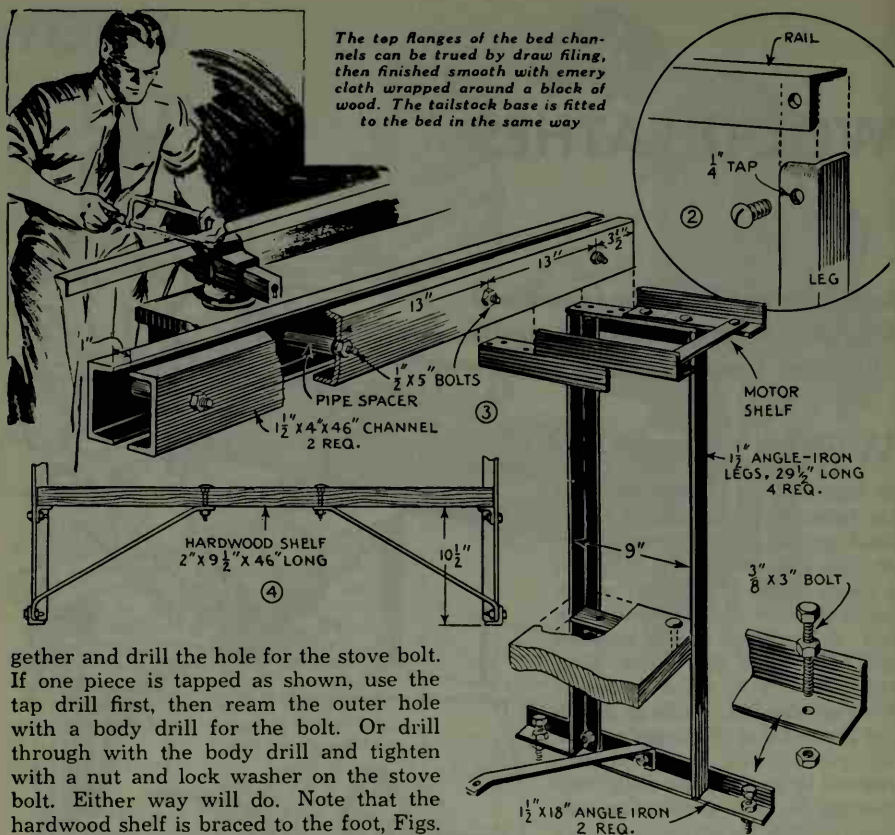
Self-contained unit has four-speed V-belt drive, rigid iron bed, and a quick-acting tailstock

WITH this lathe you can swing a disk 12 in. in diameter on the headstock or turn down a full-length table leg between centers. The headstock spindle, Fig. 1, is supported on auto connecting rods bolted to a short length of channel which forms the base and is bolted to the bed. A hardwood spacer between the rods holds the whole thing rigid. The $\frac{1}{2}$ -in. spindle runs in Ford spindle-bolt bushings which are pressed into the upper ends of the connecting rods and then reamed to give the spindle a free-running fit. The spindle also carries two ball thrust bearings, one on each side of a four-step V-pulley. Polished flat washers are used to take out the end play, if any. The inner end of the spindle should project about $\frac{3}{4}$ in. to take a hollow-sleeve spur center of the type which locks in place with a headless set screw. This and the drive pulley, also the thrust bearings, can be purchased at little cost. Faceplates are also available.

The bed is simply two channels of the size given in Fig. 3. They are bolted together with spacers cut from pipe, the latter of such length as to leave the top flanges of the channels exactly 1 in. apart when the bolts are drawn tight. Now, the stand consists of two end members joined directly to the bed as in Fig. 3, and to a lower shelf as in Fig. 4. The motor shelf is assembled from three pieces of $1\frac{1}{2}$ -in. angle as in Fig. 3. It's a good idea to make up the stand first, then



cut these pieces to suit the motor and V-belt you are to use. Fig. 2 shows a trick in fitting angle iron that should be used in building this stand, as it results in a rigid joint. After the pieces are cut to required length, file one end of the angle which meets the corner of the second angle, in this case the leg, to a contour which allows it to fit snugly. Then clamp the pieces to-

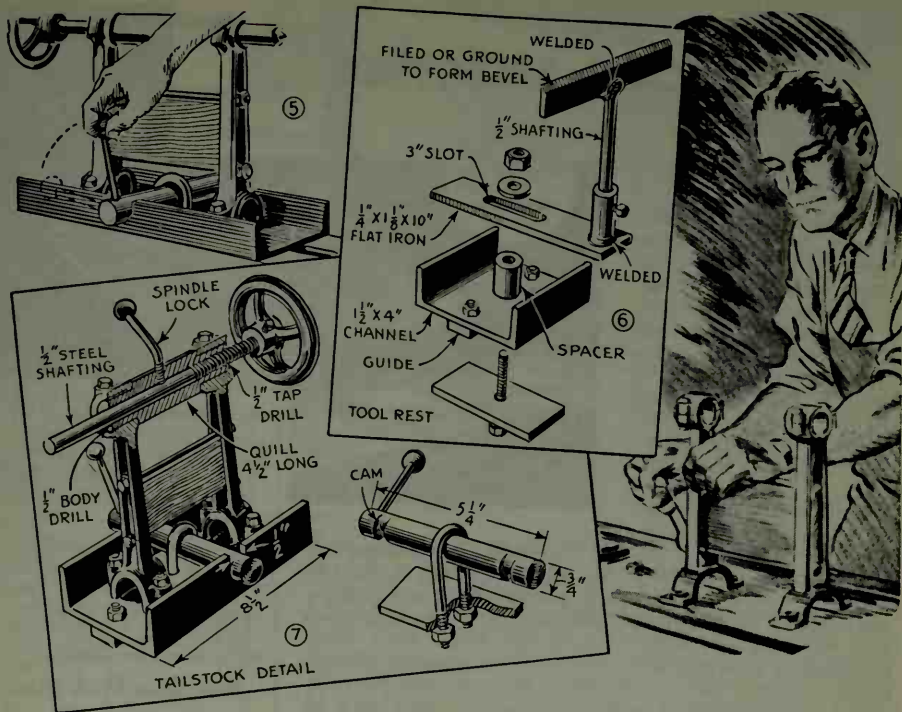


gether and drill the hole for the stove bolt. If one piece is tapped as shown, use the tap drill first, then ream the outer hole with a body drill for the bolt. Or drill through with the body drill and tighten with a nut and lock washer on the stove bolt. Either way will do. Note that the hardwood shelf is braced to the foot, Figs. 3 and 4, and that the shelf rests on an angle-iron rail to which it is bolted. Foot pieces of $1\frac{1}{2}$ -in. angle are bolted to the ends of the legs. A machine bolt or cap-screw is put through near the ends of each foot piece and held in any position with two nuts, one on each side of one leg of the angle as shown. This gives adjustment for leveling the lathe on any floor.

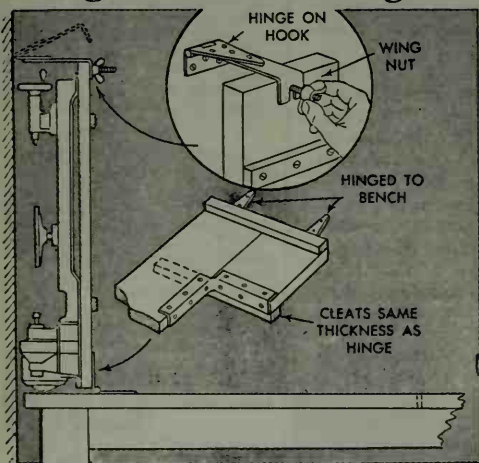
Finally, the tailstock and toolrest. Fig. 6 suggests a method of making the latter. You can purchase this item ready-made also. Figs. 5 and 7 show clearly how the tailstock is made. As you will see, it is very similar to the headstock. The quill is turned out of 1-in. cold-rolled steel shafting, the ends being shouldered back the length and diameter of the upper connecting-rod bearings leaving a center section $4\frac{1}{2}$ in. long. The quill is counterbored as shown and a portion tapped to take the threaded section of the spindle. The lock-

ing device consists of a cam rolling in slots cut in the channel-iron base as in Fig. 7 and actuated by a ball handle. The cam is made by filing slots in a piece of $\frac{3}{4}$ -in. shafting. These slots cause the shaft to move eccentrically, lifting the U-bolt and the plate which bind against the flanges of the bed and tighten the tailstock at any position.

A $\frac{1}{4}$ -hp. motor of 1,750 r.p.m. will furnish sufficient power for ordinary work. By using matched 4-step cone pulleys on motor and headstock you will not have to shift the motor to change the spindle speed. By making up hinged motor rails out of strips of hardwood or $\frac{1}{4}$ -in. flat iron it will be much easier to shift the belt when changing speeds. Hinged motor rails can also be purchased ready-made.



Hinged Lathe Swings Out of Way in Workshop



In small workshops, a woodworking lathe can be mounted on a baseboard, hinged to the workbench, to swing up against the wall when not in use, thus leaving the bench clear for other work. Cleats are nailed or screwed to the baseboard to raise it above the hinges, and angle iron, cut and bent as shown in the detail, joins the motor platform to the baseboard. The



mounted lathe is held solidly by a bolt that runs through the baseboard and into the workbench where it is held by a wing nut. When raised, the lathe is held against the wall by a length of flat iron bolted to a hinge and slotted to fit over the bolt as shown in the circular detail.

WOOD SELECTING

WARPING is one of the home craftsman's biggest headaches. After spending considerable time, money and pains-taking care in producing a fine piece of furniture, it is disheartening and a keen disappointment to have it later warp and shrink and come apart. But shrinkage and warpage can be held to a minimum by proper conditioning of the wood and by maintaining a close check of its moisture content at the time it is fabricated.

How wood warps: Wood shrinks and warps in definite relation to the direction of the annual rings, and shrinkage is about twice as great when the direction is parallel with the rings as when it is across them. This basic principle is illustrated in Fig. 4. Quartersawn (edge-grain) lumber shrinks the least because the heaviest shrinkage takes place across the narrow dimension of the board. Flat-cut boards have the greatest shrinkage across their wide dimension where it is more noticeable. Also note, Fig. 3, that flat-cut boards tend to cup away from the heart side. This is an important point and should be remembered in joinery.

Detecting warp: Any irregularity caused by warp should be removed because a board that is warped even slightly will continue to twist no matter how it is used. Cup warp, Fig. 8, is detected with a straightedge placed across the board, whereas twist or wind is determined with a pair of winding sticks, Fig. 1, or by placing a straightedge from corner to corner, as shown in Fig. 7. Both methods will reveal two high corners if twist is present, and consequently planing should be done diagonally from high corner to high corner.

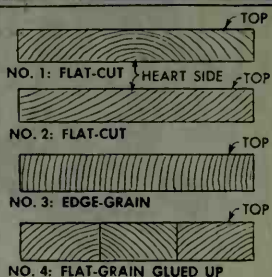
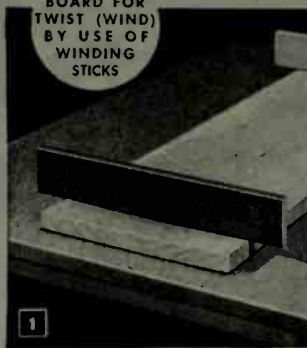
Conditioning: Conditioning means seasoning the wood to the proper moisture content (M.C.) to correspond

A TYPICAL FLAT-CUT BOARD — NOTE CUP WARP AWAY FROM HEART SIDE

STRAIGHTEDGE IN DIAGONAL POSITION WILL TEST BOARD FOR TWIST

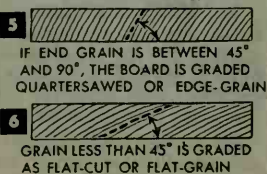
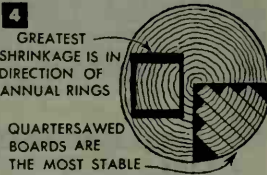
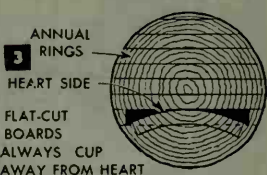


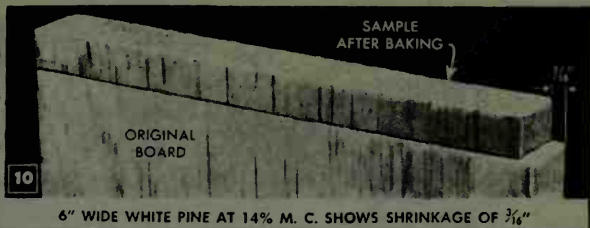
TESTING BOARD FOR TWIST (WIND) BY USE OF WINDING STICKS



Can You Pick the Best Table Top?

★ TO SCORE 100 IN THIS TEST, YOU SHOULD BE ABLE TO TELL PROBABLE WARPING ACTION OF ALL BOARDS SHOWN. END GRAIN IS KEY TO SELECTION. YOU WILL KNOW WHY IF YOU READ THE STORY





6" WIDE WHITE PINE AT 14% M. C. SHOWS SHRINKAGE OF $\frac{3}{16}$ "

BAKING WOOD SAMPLE TO FIND MOISTURE CONTENT

M.C. Calculation

WEIGHT AT START 155 UNITS
WEIGHT OVEN-DRY 136 UNITS
DIFFERENCE 19 UNITS

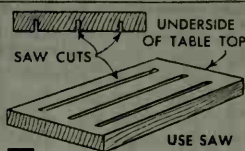
$$\frac{19}{136} \times \frac{14}{100} = \frac{266}{13600} = \frac{133}{6800} = \frac{66.5}{3400} = \frac{33.25}{1700} = \frac{16.625}{850} = \frac{8.3125}{425} = \frac{4.15625}{212.5} = \frac{2.078125}{106.25} = \frac{1.0390625}{53.125} = \frac{0.51953125}{26.5625} = \frac{0.259765625}{13.28125} = \frac{0.1298828125}{6.640625} = \frac{0.06494140625}{3.3203125} = \frac{0.032470703125}{1.66015625} = \frac{0.0162353515625}{0.830078125} = \frac{0.00811767578125}{0.4150390625} = \frac{0.004058837890625}{0.20751953125} = \frac{0.0020294189453125}{0.103759765625} = \frac{0.00101470947265625}{0.0518798828125} = \frac{0.000507354736328125}{0.02593994140625} = \frac{0.0002536773681640625}{0.012969970703125} = \frac{0.00012683868408203125}{0.0064849853515625} = \frac{0.000063419342041015625}{0.00324249267578125} = \frac{0.0000317096710205078125}{0.001621246337890625} = \frac{0.00001585483551025390625}{0.0008106231689453125} = \frac{0.000007927417755126953125}{0.00040531158447265625} = 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Woods marked "poor stability" often are suitable if properly conditioned. Be sure your wood is 8 percent M.C. You will note in Table 1 that if wood is 8 percent M.C., the initial shrinkage of a 10-in. board from green wood will be $\frac{1}{2}$ in. scant. The board also will be subjected to a seasonal cycle of about $\frac{1}{16}$ additional shrinkage and the same amount for expansion. However, you will note that near the end of a humid summer, doors and drawers will swell and bind, and that in the dry indoor air of winter they return to their original M.C. and work smoothly. Some of this normal shrinking and expanding can be stabilized by reinforcing and solidly anchoring the wood in assembly. Thus, if humidity is not excessive, the wood will compress within itself and follow the path of least resistance. However, if you fabricate wood having a 16-percent M.C., the strain of stabilization at 8 percent is just too much, and "pop" go your glue joints and fastenings.

Retarding warping: The end grain of stock roughly cut into turning squares and stored for future use should be given a protective coating of shellac, varnish or oil paint to prevent checking. Lumber salvaged from old furniture and resurfaced on one side only is more apt to warp than if surfaced on both sides, as freshly dressed surfaces invite rapid absorption of moisture. Furniture should be finished as soon as possible after it is completed. Linseed oil, shellac, varnish and other finishes, when applied to the surface of the wood, form a practically airtight covering through which moisture penetrates slowly. Finishing coats retard swelling and shrinking to the point that if the humidity increases 10 percent for a couple of days, there will be no appreciable change. If your wood is conditioned to 8 percent M.C., it will remain fairly close to 8 percent and you will not be troubled with warping. Ideas in Fig. 15 are worth noting in preventing warping and shrinking. Notice how cupping of a table top is avoided.

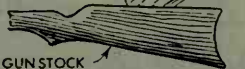
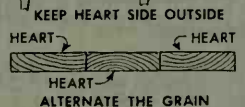
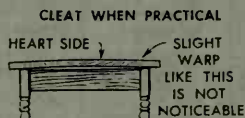


PLANER HEAD DOES CLEAN JOB OF SURFACING WARPED WOOD



USE SAW CUTS TO RELIEVE WARPING

Ideas to Prevent Warping



AFTER ROUGHING, CONDITION WOOD BEFORE FINAL CUTTING

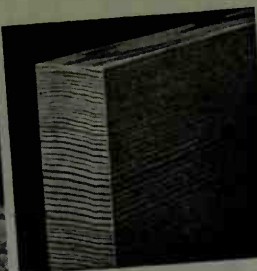
WOOD	SHRINKAGE OF WOODS*		
	Shrinkage From 12% to 6% Moisture Content		General Stability
	Percent	In. in 10"	
ASH	1.8	$\frac{3}{16}$ "	BEST
BASSWOOD	2.3	$\frac{1}{4}$ "	GOOD
BEECH	2.7	$\frac{1}{4}$ "	POOR
BIRCH	2.2	$\frac{7}{32}$ "	GOOD
CEDAR	1.3	$\frac{1}{8}$ "	GOOD
CHERRY	1.8	$\frac{3}{16}$ "	GOOD
CHESTNUT	1.7	$\frac{3}{16}$ "	BEST
CYPRESS	1.5	$\frac{5}{32}$ "	GOOD
ELM	2.3	$\frac{1}{4}$ "	POOR
FIR (Douglas)	1.8	$\frac{3}{16}$ "	FAIR
GUM (Red)	2.5	$\frac{1}{4}$ "	POOR
HEMLOCK	1.8	$\frac{3}{16}$ "	FAIR
MAHOGANY	1.2	$\frac{1}{8}$ "	BEST
MAPLE (Hard)	2.4	$\frac{1}{4}$ "	GOOD
MAPLE (Soft)	1.9	$\frac{3}{16}$ "	GOOD
OAK (Red)	2.2	$\frac{7}{32}$ "	BEST
OAK (White)	2.3	$\frac{1}{4}$ "	BEST
PINE (Yellow)	1.8	$\frac{3}{16}$ "	FAIR
PINE (White)	1.6	$\frac{3}{16}$ "	GOOD
POPLAR	1.8	$\frac{3}{16}$ "	BEST
REDWOOD	1.1	$\frac{1}{8}$ "	BEST
SPRUCE	1.7	$\frac{3}{16}$ "	BEST
SYCAMORE	1.9	$\frac{3}{16}$ "	POOR
WALNUT	1.8	$\frac{3}{16}$ "	BEST

* FLAT-CUT STOCK. SHRINKAGE OF QUARTERSAWED WOOD WILL RUN $\frac{1}{4}$ TO $\frac{3}{4}$ OF THESE FIGURES (From Table by U. S. Forest Products Laboratory)

WOOD SELECTING



1—This arch will last. It is:
(a) Hard Maple (c) Redwood
(b) White Pine (d) Red Gum



2—The end grain shows this wood has been:
(a) Slash-sawed (c) Flat-cut
(b) Quarter-sawed (d) Plain-sawed



3—Steam bending is easy with:
(a) Mahogany (c) Birch
(b) White Pine (d) White Oak



4—Careful! This wood splits:
(a) Beech (c) Sycamore
(b) Ash (d) Poplar



5—Excellent for white inlays:
(a) White Pine (c) Holly
(b) Poplar (d) Prima Vera



6—This mallet head is one of the hardest woods. It is:
(a) Harewood (c) Cocobola
(b) Chestnut (d) Amaranth



7—This shutter will be very durable against all kinds of weather:
(a) Hickory (c) Cypress
(b) Spruce (d) Basswood



8—It's easy to see this is:
(a) Bird's-eye Maple (c) Flake Figure
(b) Sycamore Burl (d) Feather Gratch



9—Excellent for boat planking:
(a) Mahogany (c) Fir
(b) Ash (d) Red Oak



10—Best wood for paint:
(a) Orientalwood (c) Maple
(b) White Pine (d) Locewood



11—This is most likely to happen when wood is:
(a) Green (c) Heartwood
(b) Flat-cut (d) Edge-grain

(9)—11
(9)—01
(9)—6
(9)—8
(9)—2
(9)—9
(9)—5
(9)—4
(9)—3
(9)—2
(9)—1
(9)—1

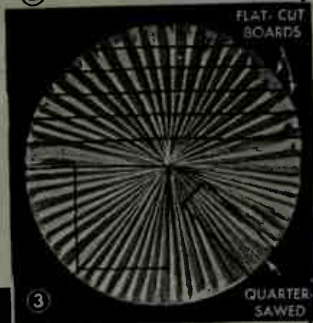
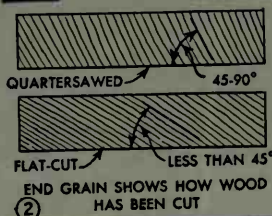
ANSWERS:

Do You
Know Your
WOODS?

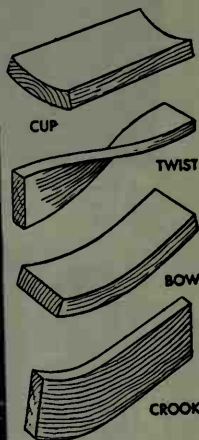
TRY THIS SIMPLE
CRAFT QUIZ

KNOWING wood not only adds to the enjoyment of crafting but also helps in making any project a success. Naturally, the crafter is chiefly interested in how the wood will look when finished, but other important features should not be neglected.

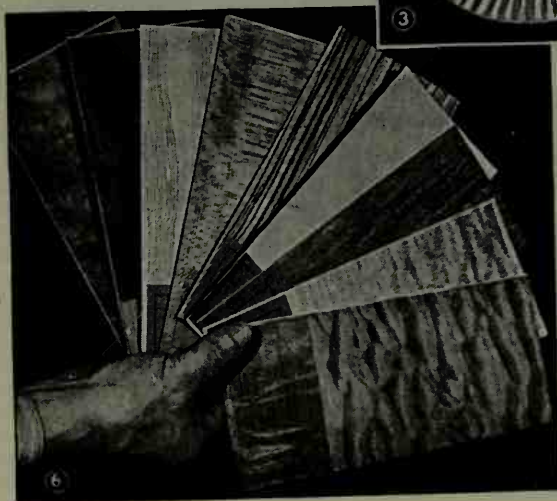
Stability: "Will it stay put?" is an important consideration in all forms of woodcrafting. All woods shrink in seasoning, which causes distortion or warp, the four principal types being shown in Fig. 4. Some woods warp more than others, as indicated in Table No. 1, and can be made more stable by proper use. The common method of testing a board for warp is shown in Fig. 1. Sticks placed at either end of the board reveal cup and also show any twist or wind. The top edge of one stick should be light and the other dark to provide maximum vision. Just what makes a board warp is often illustrated by means of a fan made from a strip of thin paper about 6 in. wide by 2 ft. long. Brush marks are drawn across the fan to represent boards sawed from a tree, Fig. 3. Shrinkage in wood always occurs along the annual rings, so that if the fan is cut on either side, it will immediately shrink just like a split log would do. What happens to the original straight boards is shown by the



SIGHTING IS A COMMON METHOD OF CHECKING TO DETERMINE AMOUNT OF TWIST OR WIND IN A BOARD. DIAGRAMS BELOW SHOW THE FOUR TYPES OF WARP



TYPES OF WARP 4



PAPER FAN ILLUSTRATES FLAT AND QUARTERSAWN LUMBER AND SHOWS EFFECT OF SHRINKAGE

Table No. 1

WORKING PROPERTIES OF COMMON WOODS

Name of Wood	General Characteristics							Machining					Remarks
	Weight Per Cubic Foot (1)	Hardness	Strength (2)	Stability (3)	Gluing	Nailing (4)	Steam Bending	Planing and Jointing (5)	Turning (6)	Sanding (7)	Shaping	Marbling (8)	
Ash	35	Med.	Med.	Best	Fair	Good	Good	Good 10-25	Fair	Best 2/0	Best	Fair	Tough—Hard to work with hand tools
Basswood	24	Soft	Weak	Good	Best	Best	Poor	Good 20-30	Poor	Poor 4/0	Poor	Fair	Excellent for toys, drafting boards, corestock
Beech	39	Hard	Med.	Poor	Poor	Poor	Good	Fair 10-20	Fair	Good 4/0	Fair	Best	Not durable outside. Hard on tools because of mineral deposits in cells
Birch	40	Hard	Strong	Good	Fair	Poor	Good	Good 15-20	Good	Fair 4/0	Best	Best	Excellent for furniture, turning, dowels, handles
Butternut	25	Soft	Weak	Best	Good	Fair	Poor	Good 10-25	Good	Fair 4/0	Fair	Fair	Furniture—Perfect for walnut imitation
Cherry	36	Med.	Med.	Good	Best	Fair	Poor	Best 10-25	Best	Best 4/0	Best	Best	Furniture, boat trim, novelties
Chestnut	27	Soft	Weak	Best	Best	Good	Fair	Good 15-20	Best	Best 3/0	Good	Good	Stains badly in contact with wet iron. Very dusty in all machining operations
Cottonwood	27	Soft	Weak	Fair	Best	Best	Poor	Poor 5-20	Poor	Poor 4/0	Poor	Fair	Excellent for boxes and other nailing jobs. Wears very well for a soft wood
Cypress	29	Soft	Med.	Good	Fair	Fair	Poor	Good 15-25	Poor	Fair 2/0	Poor	Poor	Tends to splinter. Most durable of American woods for outdoor and soil exposure
Elm (Southern)	34	Med.	Med.	Poor	Fair	Best	Good	Poor 15-20	Poor	Good 2/0	Poor	Good	Very durable under paint. A good furniture wood despite difficulties in machining
Gum (Red)	33	Med.	Med.	Poor	Best	Good	Fair	Fair 10-20	Best	Fair 4/0	Fair	Fair	One of the most used furniture woods for imitations of walnut and mahogany
Hickory	42	Hard	Strong	Good	Good	Poor	Good	Good 10-25	Good	Best 2/0	Fair	Best	Excellent for furniture and long a favorite for steam bending, tool handles, wheels
Magnolia	30	Soft	Weak	Fair	Best	Best	Best	Good 5-15	Fair	Good 4/0	Good	Poor	Excellent for steam bending, although little used as such. Often marketed as poplar
Mahogany	35	Med.	Med.	Best	Best	Good	Poor	Good 5-25	Best	Good 4/0	Best	Best	One of the best furniture woods
Mahogany (Phil.)	33	Med.	Med.	Best	Best	Good	Poor	Good 5-25	Good	Poor 3/0	Fair	Fair	Generally coarser and softer than true mahogany. Furniture, boat planking, trim
(9) Maple (Hard)	41	Hard	Strong	Good	Fair	Poor	Fair	Fair 15-20	Good	Good 4/0	Best	Best	Fine furniture, flooring, turnings, bowling pins. One of the best hardwoods
Maple (Soft)	31	Med.	Med.	Fair	Good	Fair	Fair	Poor 10-15	Fair	Good 4/0	Fair	Poor	Same uses as hard maple but an inferior wood. Difficult to machine smooth
Oak (Red)	39	Hard	Strong	Best	Good	Good	Best	Best 10-25	Good	Best 2/0	Fair	Best	Substitute for white oak in cheaper work
Oak (White)	40	Hard	Strong	Best	Good	Good	Best	Best 10-20	Good	Best 2/0	Good	Best	Interior trim, floors, furniture. One of the most used American woods
Pine (White)	25	Soft	Weak	Good	Best	Best	Poor	Good 10-25	Good	Fair 2/0	Good	Fair	Best all around soft wood. Excellent for paint
Pine (Yellow)	38	Hard	Strong	Fair	Fair	Poor	Poor	Good 10-25	Poor	Fair 2/0	Good	Good	Main uses—House construction, trim, floors
Poplar	29	Soft	Weak	Good	Best	Best	Fair	Good 5-20	Good	Poor 4/0	Poor	Fair	Excellent for carvings, toys, corestock
Redwood	29	Soft	Med.	Best	Best	Good	Poor	Good 10-25	Fair	Poor 2/0	Good	Poor	Excellent for outdoor furniture, window sills, etc.
Sycamore	35	Med.	Med.	Poor	Good	Best	Poor	Poor 5-15	Good	Poor 3/0	Poor	Best	Interior trim, furniture. Difficult to machine, but excellent appearance
Walnut	36	Med.	Strong	Best	Best	Fair	Good	Good 15-20	Best	Best 4/0	Good	Best	Has every good feature for furniture and cabinet work

NOTES

Data in this chart is largely from extensive tests made by U. S. Forest Products Laboratory, with some additions.

1. Pounds per cubic foot, dry. All woods vary in weight, even in the same tree from trunk to top. A variation of 10% or over under average should be allowed.
2. Composite strength value. Woods rated weak are strong enough for all average work.
3. Rated as unrestrained warp. Most woods are quite stable if properly seasoned and cared for.
4. Rated an ability to take nails near and without splitting.
5. All flat grain stock, shallow cut. Rating is average

from runs at 15, 20 and 25-degree cutting angles. Bottom figure is best knife angle for smooth cutting.

6. Rated on smooth cutting and ability to hold detail. Not much difference between best and good.
7. Rated on freedom from fuzz. Bottom figure is coarsest abrasive grit which can be used without scratching.
8. Rated on smoothness of cut. Work speed decreases with hardness of wood and this factor might be of more importance than smoothness in production work.
9. Sugar, white or hard maple. Should be distinguished from silver, red, big-leaf or soft maple, which is an inferior machining wood although often marketed simply as "maple."



fan, Fig. 5. The flat-cut boards always curl away from the heart and the square timber shrinks badly on one side, but the quartersawed board is quite stable. From these observations, it is apparent that quartersawed lumber is preferable for maximum stability. Also, if the board is cupped, it is certain that the rounded side is the heart side. Fig. 2 shows how the end grain indicates the type of sawing. Quartersawed lumber also is known as radial-grain, edge-grain, rift-grain and comb-grain. Flat-cut lumber is variously named slash-grain, bastard-grain, plain-sawed and tangential cut.

The right side: When using flat-cut lumber, keep the heart side toward the outside surface of the work. Then, if the board does cup, it will show rounded on the face, which is much better than a hollow and much stronger structurally. An exception is painted wood used outdoors. Paint holds better on the bark side and there is less danger of the grain shelling out.

Moisture content: Wood for furniture will be stable if the moisture content is from 6 to 8 percent. This is obtained automatically if the wood is stored for three or four weeks in the same atmosphere at which it will be used. Lumber from commercial dry kilns has a moisture content of about 8 percent. Lumber air-dried outdoors will have a moisture content of about 20 percent, and should not be used for furniture until it has seasoned three or four weeks indoors. Sometimes it is a good idea to check the moisture content of wood before using it. Weigh a small sample exactly and then put it in the kitchen oven. Check the weight at intervals until the wood ceases to lose weight. Ascertain the weight difference and divide by the bone dry weight to get the moisture content. For example, if the test piece weighs 10 oz. at the start and 8 oz. oven dry, the difference is 2 oz., representing moisture, or 25 per-



cent moisture content. The test can be done in a half hour by splitting the sample into thin strips to hasten drying.

Machining: Some woods machine much better than others. Note in Fig. 7 how walnut takes a smooth jointer cut, while soft maple is very rough. Suitability of various woods for machining is indicated in Table No. 1. Jointing, Fig. 9, is the most important test. Other than the wood itself, the method of machining affects the finished work. This can be observed in jointing, where much better work often can be done by changing the rake angle of the knives. Most small jointers have the knives fixed at about 30 degrees rake. This is excellent for knife efficiency, but the sharp angle tends to tear the grain of many woods. For production work in these woods it is advisable to reduce the rake angle by using shims or grinding a front bevel as shown in Fig. 8. Other useful characteristics of woods are given in the table. The "hardness" column lists woods according to whether they are physically hard or soft. Generally, the botanist's classification of hardwoods (broad-leaved trees) indicates a physically hard wood, but there are several exceptions, including such hardwoods as basswood, poplar, cottonwood and aspen, all of which are quite soft. Exceptions in reverse also will be found. Yellow pine, for example, although botanically a softwood (coniferous or needle-leaved trees), is actually harder than many hardwoods. If the wood is hard, it is always heavy without exception; if the wood is hard, it generally is strong.

Table No. 2

WOODS-FINISHING DATA

Note: NGR = Non-Grain-Raising
(Applies to stain)

	Natural Color	Usual Grain Figure	Stain		Filler		Bleach	Point	Natural Finish	Remarks
			Type (1)	Color	Wt. (2)	Color				
Alder (Red)	Pink to Brown	Plain or Figured	Wiping or Water	Red or Brown	None		Yes	Yes	Yes	Principal hardwood of Pacific coast. Like red gum
Amaranth (Purpleheart)	Purple	Mild Stripe or Mottle	None		None or 6	Match Wood	No	No	Yes. Pref.	Usually finished natural to retain purple color
Ash (U.S.A.)	White to Brown	Plain or Fiddleback	Any	Any	15	White or Brown	Yes	Yes. Fill First	Yes	White filler used for frosted finish (3)
Basswood	Cream	Very Mild	NGR	Red or Brown	None		Not Nec.	Yes	No	Fuzzy grain. Usually muddy under oil stain
Birch	Cream	Mild	Any	Walnut or Mahogany	8	Natural or Brown	Yes	Yes. Interior	Yes	Used extensively for walnut and mahogany
Butternut	Heart: Amber Sap: Cream	Like Walnut	Water	Walnut or Oak	14	Medium Brown	Yes	No	Yes	Good for amber walnut without bleaching
Cedar (Aromatic Red)	Heart: Red Sap: Cream	Knotty	None		None		No	No	Yes. Pref.	Red wiping stain can be used to blend sap wood
Cherry	Red to Brown	Good	Water	Red or Brown	6-8	Red to Black	No	No	Yes	Takes excellent finish. Good for brown mahogany
Chestnut	Gray-Brown	Heavy Grain	Oil or Wiping	Red or Brown	15	Red or Brown	No	Yes	Yes	Large pores. Good for novelty finishes (3)
Cypress	Heart: Brown Sap: Cream	Plain or Figured	Water, Oil or Wiping	Red or Brown	None		No	Yes (6)	Yes	Good for sand blast (4) If water stained, see (5)
Ebony	Dark Brown to Black	Plain or Stripe	NGR	Dark Red or Brown	None or 3	Brown or Black	No	No	Yes	Oily. Gaboon ebony is blackest
Elm (Southern)	Brown to Cream	Heavy Grain	Water	Red or Brown	12	Dark Brown	No	Yes	Yes	Cross-grained. Sometimes hard to get even color
Fir (Douglas)	Cream to Red	Plain or Wild	Wiping or Oil	Brown	None		No	Yes (7)	No	Good for sand blast (4) Not pleasing stained
Gum (Red)	Heart: Br. Red Sap: Cream	Plain or Figured	Any	Red or Brown	None or 3	Match Wood	Yes	Yes	Yes	Most used wood for walnut and mahogany imitations
Hickory	White to Cream	Usually Straight	Water	Red or Brown	15	Brown	Yes	No	Yes	Good walnut or mahogany—blend finishes
Holly	Silver White	Mild	Water	Amber	None		Not Nec.	Yes	Yes	One of the whitest woods. Usually finished natural
Magnolia or Poplar	White to Yellow	Mild	Oil or Water	Red or Brown	None		No	Yes	No	Usually painted. Makes fair satinwood imitation
Lacewood (Silky Oak)	Medium Brown	Flake	Water	Oak or Lt. Walnut	12	Dark Brown	Fairly Well	No	Yes	Excellent cabinet wood. Very decorative
Mahogany	Brown to Red-Brown	Stripe	Water	Red or Brown	12	Red to Black	Yes	No	Yes	Best known cabinet wood. Excellent for finish
Mahogany (Philippine)	Brown to Red-Brown	Stripe	Water or Wiping	Red or Brown	18	Red to Black	Yes	No	Yes	NGR stain preferable to minimize grain-raising
Maple	Cream	Varied	Water and Wiping	Maple	None		Yes	No	Yes	Use NGR stain and tone with wiping stain after sealer
Oak (English Brown)	Deep Brown	Plain, Flake or Swirl	NGR	Brown	15	Brown to Black	Yes	No	Yes	One of the best cabinet woods. Also "Pollard Oak"
Oak (Red)	Red-Brown	Plain or Flake	NGR	Green Toner (B)	15	Brown	Yes	Yes	No	Bad grain-raising with water stain, hence NGR stain preferable. Good for novelty finishes (3)
Oak (White)	White to Light Brown	Plain or Flake	NGR	Brown	15	Brown	Yes	Yes	Yes	
Orientalwood	Light Brown	Stripe Crossfire	Water	Amber or Brown	12	Brown	No	No	Yes	Good walnut effects
Pine (White)	White to Cream	Mild	Water (5) or Oil	Brown Only	None		No	Yes	No	Best for painting
Prima Vera	Yellow-White	Stripe Crossfire	Water	Amber	12	Natural or Dark	Yes	No	Yes	Also "White Mahogany". Excellent "bland" color
Redwood	Red	Mild St. Grain	Red only for toning		None		No	Yes	Yes	Excellent exterior wood. Best painted
Rosewood (Brazil)	Red-Brown	Varied	NGR	Red	15	Dark Red or Black	No	No	Yes	Oily. Wash off with lacquer thinner before staining or finishing
Rosewood (East Indies)	Red-Purple	Stripe	NGR	Dark Red	12	Dark Red	No	No	Yes	
Sapeli	Medium Brown	Stripe	Water	Red or Brown	10	Dark Brown	No	No	Yes	Very similar to striped mahogany
Sycamore	White to Pink	Flake	Water	Amber or Brown	None		Seldom	Yes	Yes	Good for natural finish
Walnut	Heart: Brown Sap: Cream	Varied	Water	Walnut	14	Brown to Black	Yes	No	Yes	Obtainable in all figures
Zebrawood	Tan with Brown Stripe	Heavy Stripe	Water	Light Oak	12	Natural	No	No	Yes	Very pronounced grain. Good for modern effects

NOTES

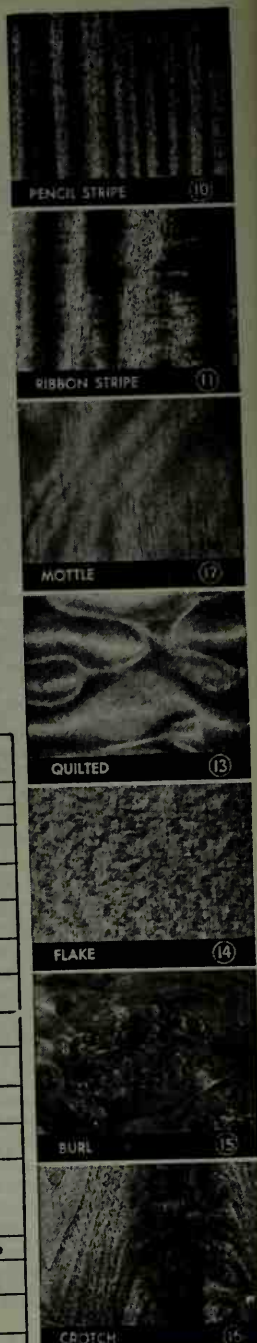
- Where water stain is indicated, NGR (non-grain-raising) stain can also be used. "Oil" means penetrating oil stain; "wiping" means wiping oil stain.
- Pounds of filler paste per gallon of thinner.
- All coarse-grain woods are good for novelty finishes, using contrasting filler, usually white.
- Woods with alternate hard and soft streaks can be sand-blasted or burned with torch to cut out soft wood.
- Water stains take better on resinous woods if wood is first sponged with 4 oz. sal soda and 1 oz. washing soda to gallon of water.
- Add 1 pt. benzol per gal. of paint for better penetration (primer only).
- Special sealers available to kill grain.
- For brown tones, first spray weak green stain to kill red color of wood.

Finishing: Finishing often is the prime characteristic in selecting a cabinet wood. When you have a wood that machines and finishes nicely, then you have a top-notch cabinet wood. Information given in Table No. 2 will help in selecting a wood for finish, and is a fair guide as to how the wood should be finished. Finishing is closely related to the natural beauty of the wood, necessitating some knowledge of grain and "figures" for suitable selections. Figures in wood constitute a whole subject in themselves, and the few samples shown in Figs. 10 to 16 can be taken only as typical examples. Perhaps the best way to become acquainted with figures and also the many different kinds of woods is to purchase a set of wood samples, Fig. 6. A set of fifty samples is an inexpensive and worthwhile investment, and it is surprising how quickly identification and general knowledge of various woods can be learned by "leafing" through such a set. The samples are small wood blocks packaged in a neat box and should be kept in a clean, dry place.

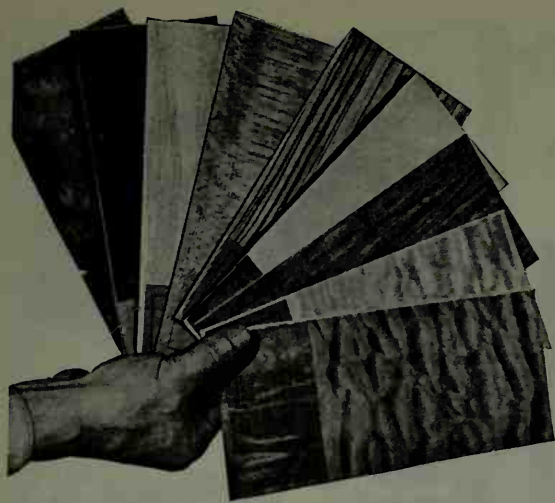
Grading of wood: A knowledge of wood grading is useful. For example, if you want a poplar board for painting, you would order "stained saps," (fifth-grade lumber), and the finished job would be practically as good as if made from "firsts and seconds." Essential grading data is given in Table No. 3. This table is not complete nor absolutely accurate, but it can be taken as a general guide. There are actually ten grades of lumber. Of these, eighth and ninth grade mahogany is the only one of interest to the crafter. This grade comprises wood of firsts and seconds quality but in short lengths. It should be noted in the table that numbered gradings are not comparable between different woods. For example, fifth grade poplar is a much better wood for a paint job than fifth grade chestnut. Grading rules for softwoods are much different than for hardwoods, and the differences should be carefully noted from the table.

Table No. 3 GRADING OF WOODS (Condensed)

Hardwoods	General Grading—Indicates let-down in quality					
	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade
Ash, Beech, Birch, Hard Maple, Red Alder	Firsts and Seconds		Selects	No. 1 Common	No. 2 Common	Sound Wormy
Cherry	Firsts and Seconds		Selects	No. 1 Common	No. 2 Common	No. 3A Common
Chestnut	Firsts and Seconds		Selects	No. 1 Common	Sound Wormy	No. 2 Common
Cottonwood, Red Gum	Firsts and Seconds		Selects	No. 1 Common	No. 2 Common	No. 3A Common
Elm, Hickory	Firsts and Seconds		No. 1 Common	No. 2 Common	No. 3A Common	No. 3B Common
Mahogany	Firsts and Seconds		Selects	No. 1 Common	No. 2 Common	No. 3 Common
Red Oak, White Oak Locust, Sycamore	Firsts and Seconds		Selects	No. 1 Common	No. 2 Common	Sound Wormy
Poplar	Firsts and Seconds		Saps	Selects	Stained Saps	No. 1 Common
Walnut, Butternut	Firsts and Seconds		Selects	No. 1 Common	No. 2 Common	No. 3 Common
Firsts—About 91% clear both sides. Selects—90% clear one side. Seconds—About 83% clear both sides. No. 1 Common—About 75% clear face. Firsts and Seconds—Best commercial No. 2 Common—About 66% clear face. grade. Not less than 20% firsts. Sound Wormy—No. 1 common but with wormholes.						
Softwoods	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade
Boards	A Select	B Select	C Select	D Select	No. 1 Common	No. 2 Common
Dimension Stock	No. 1 Common	No. 2 Common	No. 3 Common			
A Select—Clear and suitable for natural finish. B Select—Allows a few small defects but suitable for natural finish. C Select—Allows a few defects which can be covered by paint. D Select—Allows any number of defects, which can be concealed by paint. No. 1 Common—Sound and tight-knotted wood						



FIGURES IN WOOD ARE VARIED WITH ABOUT 25 RECOGNIZED STYLES, A FEW OF WHICH ARE SHOWN ABOVE



Treatment of VARIOUS WOODS

FIRST CONSIDERATION in any finish should be given the kind of wood — don't expect fir to look like walnut or limed oak. Here are quick thumbnail finishing sketches of a wide variety of woods commonly used by the craftsman

ASH—Takes all stains well. Requires heavy filler for all level finishes. Sometimes finished without filler, especially in its natural light color. Makes a good gray with silver-gray stain and gray filler. All finishes are usually dull-rubbed or waxed.

BIRCH—Has small pores and can be finished with or without filler. Makes good walnut, mahogany or cherry finish. Attractive and widely used in natural finish. Bleaches.

CEDAR—Requires shellac sealer coat to seal the oil in the wood. Red and white areas can be blended closer together with use of Venetian-red oil color reduced with naphtha and applied with rag. No finish should be applied to interior of chests, closet linings, etc.

CHERRY—Attractive in light brown or red. Does not bleach. Small pores need not be filled although a thin filler is useful. Usually rubbed and polished except in antique finish, which should be satin or dead flat.

FIR—Not a good cabinet wood, but extensively used in plywood form for paneling. Wild grain and tendency to check is greatly minimized by the use of synthetic resin primer, which should be used for both clear and enamel finishes. Does not bleach, although a novelty effect with very pronounced grain can be obtained by bleach which will act only on soft, light-colored portion of wood.

GUM—Red gum, satin walnut. Finish with or without filler. Attractive in natural finish or can be stained to imitate walnut or mahogany. Bleaches.

KORINA—Creamy gray color is attractive in natural finish. Grain and pores similar to mahogany and requires same filler base. Makes perfect red or brown mahogany when stained. Can be bleached for very light tones.

MAHOGANY—True mahogany should be finished only as mahogany in various standard shades of red and brown. Avoid dark stains. Bleaches well although medium light tones are more easily obtained by using primavera or korina in natural color. All mahoganies and especially the substitutes—African, Philippine, Tanguile, etc.—tend to whisker under water stain and are best finished with nongrain-raising stains. A natural finish without stain is attractive, using natural filler.

MAPLE—Requires no filler. Selected white wood can

be used for modern blond tones, with or without staining. Brown and red tones are usually obtained with a double-staining technique (see page 14). Bleaches, except mineral streaks do not respond.

OAK—Over 300 varieties, all of which can be generally classed red or white. White oak is superior. Pores are very open and require a heavy filler base of 15 lbs. for level finish. No stain required for natural, light or golden colors. No filler required for certain period finishes such as Jacobean, Weathered and Mission. Excellent for novelty finishes with filler contrasting against the stained color of the wood. Good for gray finishes with gray stain, gray filler. Good grays can be obtained on red oak by first treating the wood with a light green stain to kill the pronounced red color.

PINE, White—Not a cabinet wood but attractive in natural and stained finishes for woodwork. Most varieties are subject to some pitch bleeding and should be sealed with a first coat of synthetic resin primer, using clear for clear finishes, white for enamels. Not attractive in red colors and should be stained brown only. Makes fair maple substitute. Can be blonded with white wiping stain.

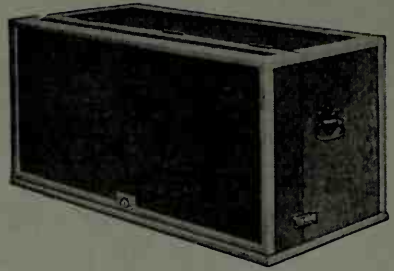
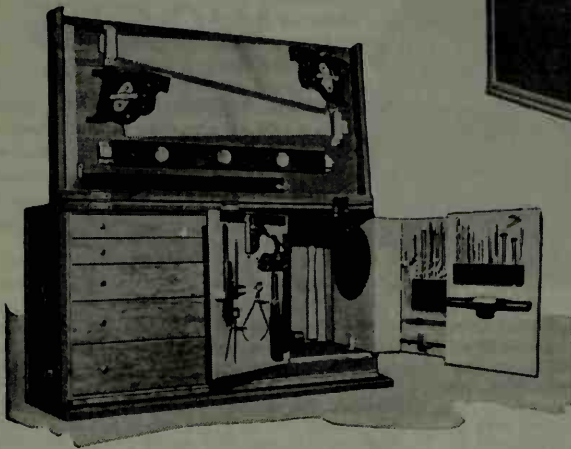
PINE, Yellow—Stranger grain than white pine but can be tamed with clear resin primer. Extensively used for woodwork in natural finish. Does not bleach. Excellent for enamel with resin primer, or can be treated as per Note 5 on opposite page.

ROSEWOOD—Oily and should be washed with lacquer thinner immediately before finishing. Brazilian rosewood is usually finished with a light-red stain, mahogany filler; East Indian takes dark-red filler.

SYCAMORE—Excellent in natural creamy finish; can be bleached for lighter tones. Also attractive in rich brown obtained with water or NGR stain.

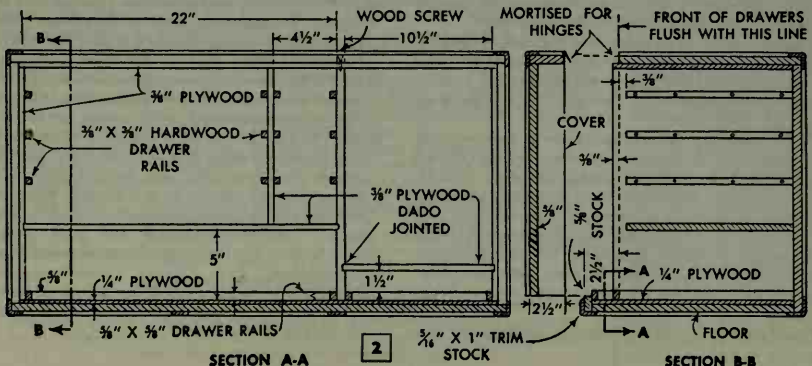
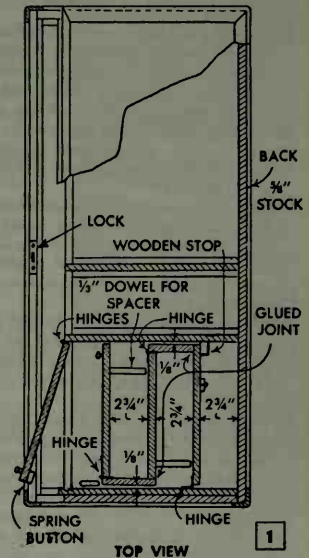
WALNUT—Excellent in all shades of brown, never red. Sap wood is creamy and requires extra stain coat to match. Excellent color can be obtained with use of hot linseed oil. Pores are usually filled, matching the stained color of wood or darker. Bleaches and is attractive in amber and gray tones. Red gum is used for imitating. Oriental wood is perfect substitution.

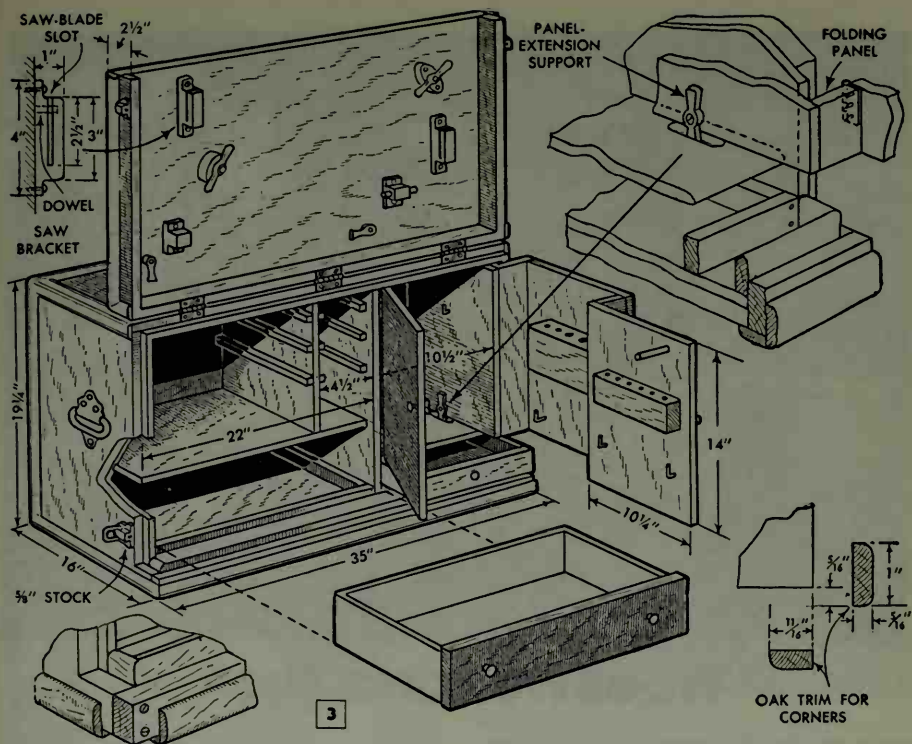
ZEBRAWOOD—Pronounced stripe is best retained with natural finish, using natural filler over a wash coat of shellac or lacquer.



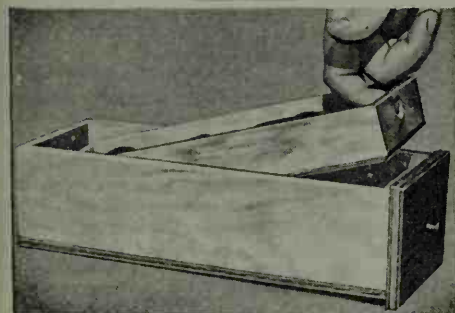
Woodworker's TOOL CHEST

THERE'S a place for each tool and you'll know just where to find it if your woodworking tools are kept in a chest like the one built by Vernon Cutler of Bremerton, Wash. In addition to its convenience and efficiency, this chest conserves workshop space and, if constructed with close-fitting joints and lid, it appreciably retards tool rust. The chest has a spacious drawer for storing planes and other large tools, nine smaller drawers, a tool panel that folds compactly into its compartment, and plenty of room on the inside of the lid for hanging saws, a level and a square. Even the space between the large drawer and chest bottom can be utilized





Above, roomy bottom drawer provides ample storage space for planes or other large tools. Below, drawer inserts permit the number of compartments to be increased without the installation of extra drawers



for storing blueprints, magazine plans and pamphlets.

The outer shell of the chest is of cedar with all corners and edges protected by oak trim. The top and sides are lined with $\frac{3}{8}$ -in. plywood panels and the bottom with $\frac{1}{4}$ -in. plywood. These liners extend $\frac{3}{8}$ in. beyond the front edges of the top and sides to form a rabbet for the lid, Fig. 1 and Fig. 2, section B-B. Two $\frac{3}{16}$ by 1-in. oak cleats are fastened across the bottom of the chest to give additional support. The vertical partitions and hardwood drawer runners are inserted as in Fig. 1 and Fig. 2, section A-A. All drawer fronts and the door for the tool-panel compartment should fit flush with the chest sides.

The tool panels are hinged and fitted as in Fig. 1, leaving at least $\frac{1}{8}$ -in. clearance between each wall of the compartment and the panels when they are folded. Note the wooden stop and the dowel spacers for the panels. The extension support, upper right-hand detail, Fig. 3, holds the tool panels in the open position. The lid is constructed in the same way as the rest of the chest, and is mortise-hinged to the chest top. Fig. 3 shows fixtures for mounting tools on inside of lid.



WOODWORKING SHOP

WOODWORKING leads all other homeshop hobbies. It is the most lasting and also the most satisfying. One of the most powerful appeals of wood to all workers is the ease with which it can be fashioned into useful products. Power tools have made it possible for the average skilled worker to saw four legs, cut and mold a top, make the mortises, and emerge from the basement with a nice table—all in one evening. He can make novelty lawn figures in a matter of minutes by simply tracing around a plan and then cutting it out on the jigsaw. Before the clock folds its hands he can turn a neat bedroom lamp, fashion a jewel box of exotically grained wood, or shape and nail a picture frame.

The typical wizard in wood is a married man. He has about five power tools and four motors. His shop is in the basement and measures about 12 x 20 ft. The whole layout cost him about \$500. He works in it on an average of about two nights a week, with occasional spells of concentrated effort. He allows the whole works to rust during the summer months. He turns out an amazing number and variety of projects, most of which are doomed to collect dust in the attic or supply splendid splinters for a quick morning fire. As time goes by he becomes increasingly critical of both his tools and his projects. Eventually he falls in love with wood itself—the cool, smooth caress of maple, the rippling crossfire of mahogany



DATA . . .

SHOP SIZE

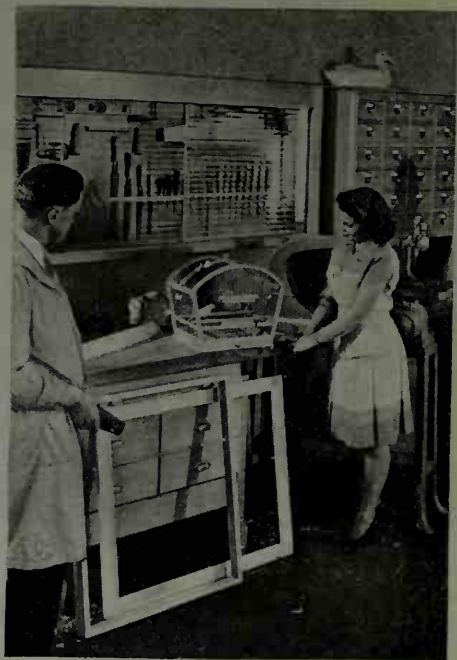
12 x 20 ft. (½ of full basement) is the average shop size. This is 240 sq. ft.

TOOLS

The complete woodworking shop needs a jigsaw, bandsaw, bench saw, belt sander, drill press, wood lathe and jointer, together with accessories and hand tools

COST

Complete equipment means an outlay of between \$400 and \$1200. The average is about \$500, laid out over three years



Woodworking projects comprise everything from bird cages to furniture, finally call for top craftsmanship

and the intricate patterns of crotch walnut.

Wood seasons slowly, and so must the man who works it. The actual beginnings of a woodworking shop are simple and prosaic. All you do is buy a jigsaw or a circular saw for your first tool. You put it down in the middle of the basement and hook it up with an extension cord to the nearest available electric outlet. Obviously you have no need of a floor plan. If this first tool is a circular saw, you will spend some time reading all about how it is adjusted and operated, because you have read somewhere that a circular saw can cut off your fingers with dreadful accuracy when improperly handled. After ripping and cross-cutting a few boards, you come to realize that your saw is not exactly a monster if you treat it right. You make a few shelves as dictated by the lady of the house. After that, most of the enthusiasm will evaporate, since the circular saw is not in itself a complete shop. You start thinking, "What I should have bought was a jigsaw; then I could have made a rocker for the baby." So you start saving your money and anticipating the things you will make after you get a jigsaw. You are on your way.

The location of the shop is the first problem. Generally it means that you are going to take over at least half, if not all of the basement. If you don't have a basement, you'll be planning your shop for an extra room in the house or in the attic. Garage workshops are not so hot (the expression is well-chosen for winter, the workshop season). Obviously the best location is a spot where you can have available the heating, lighting and plumbing facilities of the home. If you do average woodworking, the basement is just right as to temperature, because it will be about 65° to 68° when the rooms above are from 70° to 80°. The garage workshop or the separate outdoor shop becomes increasingly practical as enough time is spent in it to justify a heating system. But as a starter, one lone power tool sitting in a cold garage is no incentive to production. Some of the "plushiest" shops are built in a separate wing of the home, but these supershops are reserved strictly for men who have been in the craft long enough to justify the expense.

You will want to acquire new tools as quickly as possible. You will buy or build a workbench and put up a tool panel. You will make a shelf and line it with glass jars for hardware. All this comes in the first year of woodcrafting. Even when money is no object, it is not too smart to install an



One of the nicest things about woodworking is the ability to make things for the next generation—especially your own contributions. A jigsaw plus one evening will make the above duck rocker

entire shop in one move—you rob yourself of a lot of pleasurable anticipation and end up with a bunch of strange machines for which you have no feeling and which you cannot run as expertly as tools which have been acquired individually.

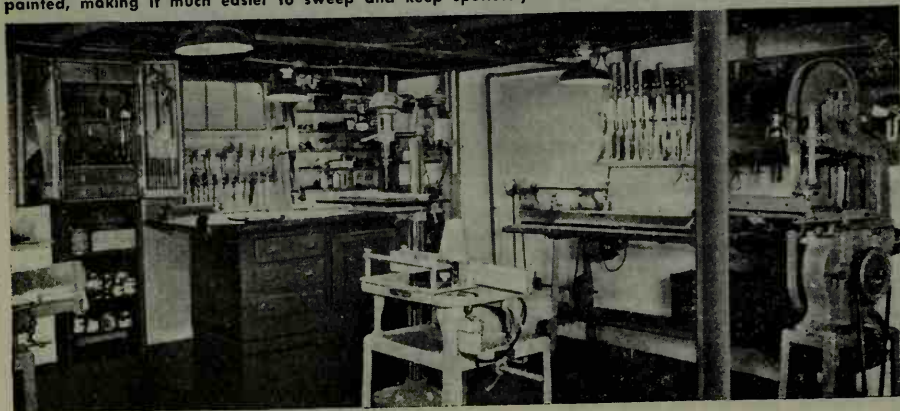
The exact order in which you buy your tools will be dictated by what you do. You will need at least four of the six basic machines before you can even consider any of the more specialized tools. Broadly speaking, the jigsaw is the best first tool. This might be followed by a drill press, a circular saw, and a wood lathe. When you have these four tools you can build almost anything in wood. The cost of these four machines, in light but good-quality equipment, is about \$190, without motors.

The problem of motors is the beginner's main headache. A good motor costs about as much as a light power tool itself. Usually, you double up at first, making use of some system which permits the running of two or more power tools with one motor.

All of these problems—the selection of the first power tools, the arrangement of the shop, and the purchase of additional equipment are treated extensively in other sections of this book. But it is well to be forewarned of the problems that lie ahead.



Above: An excellent example of a spare-room or attic workshop. Below: A good basement-shop layout. The concrete floor has been painted, making it much easier to sweep and keep spotlessly clean





More WOODWORKING Tools

AFTER you have acquired about four of the six basic tools, you will begin to cast your eye at other equipment. By this time you will be appreciative of the fact that hand sanding is hard work. "Boy, if I just had a belt sander or a portable job!" And so, first the thought and then the deed.

Prices for sanders start at about \$40 and it takes a little picking to decide exactly what you want. Definitely, it must be belt-faced. In floor or bench machines, these can be obtained in 4 or 6-in. widths. Like the jointer, the 4-in. is as good as the 6-in. for edge work, while the 6-in. or any other size is never big enough for surfacing jobs. Combination units combining a belt and disk, as in the photo above, are excellent for general craftwork. The individual belt sander in a 6-in. width is a justly popular machine. Most belt sanders can be tilted to work either horizontally for surfacing or vertically for edge work. However, the conversion feature is of no great value—you use the machine one way or the other and that's that.

One of the difficulties in selecting sanding equipment is the fact that no one machine will do everything. While a bench or floor belt sander will probably be your first choice, you will immediately find out you can't sand a boat with it and you can't sand that beautiful piece of mahogany plywood you have worked up for a table top. The



Atlas; Boice-Crane; Porter Cable

Sanders save a lot of hard work. Top photo shows a combination belt and disk machine. Above: The big stroker-type sander. Below: The popular portable type, handy and suitable for most homeshop projects





A shaper does the fancy edge work in home furniture construction. A ½-hp. shaper is the best size for average homeshop work



Delta photos

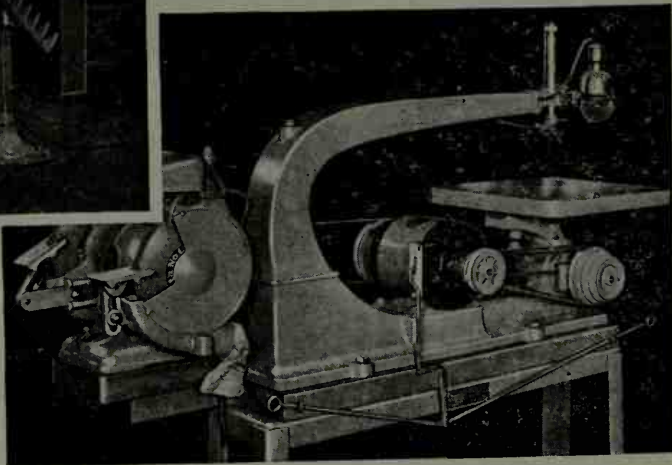
A grinder is handy in any shop but not essential. Above: The pedestal, direct-drive type. Right: The belt-drive grinder can be driven from jigsaw or other motor. The 6 or 7-in. wheel size is popular

proper tools for these jobs are the portable sander and the stroker-type belt, as pictured in the photos on page 27. Unfortunately, the cost is high and the need not too pressing, so these machines stay in the realm of "I wish" as far as most crafters are concerned. When you buy any sander, don't forget the motor. Any type of abrasive surface offers a tremendous resistance when work is held against it—the 6-in. belt or 12-in. disk should be powered with nothing less than ½ horse.

If you do furniture work, you may consider a shaper. This is one machine that has wonderful possibilities for a wide variety of work—but—you can do most of the jobs fairly well on other machines. The cleanest and cheapest setup for shaping wood edges is the molding or coping head used on the circular saw. The use of ½-in. cutters on the drill press is often substituted, but is not nearly as clean in action.

Most shops eventually get around to a grinder, but this is another tool you can do without for a long time. If you have a wood shop, sole use of the grinder will be to sharpen tools. For this small amount of work, it is simple and satisfactory to use a grinding wheel mounted in the lathe or drill press. However, a belt-driven grinder is inexpensive and often worth-while. Usually it can be driven from some other machine, such as the jigsaw setup shown below, so it doesn't have the bug of motor cost being more than the machine.

What else? Well, it depends pretty much on what you do. No crafter, once he gets started in the business, is troubled much by what tools he must have next. For one thing, you don't really need them. Once you are set up with a buzz saw, a drill press, a wood lathe and a bandsaw, you can make a pretty fair stab at almost anything. However, just to complete the picture, additional tools get the once-over on the following page.





HAND GRINDER is the big little tool for a thousand jobs. Two sizes are most popular, one taking $\frac{1}{8}$ and $\frac{5}{32}$ -in. shank tools, the other all shanks to $\frac{1}{4}$ in. The small size has high speed, is excellent for most light work. The larger size runs slower, packs more wallop for heavier work



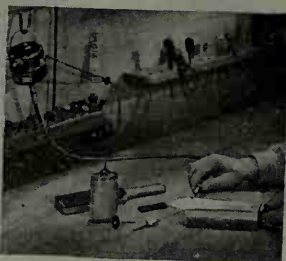
PORTABLE SAW has limited uses in the home workshop. The small model with swinging $4\frac{1}{2}$ -in. blade costs less than \$50



GEM-CUTTER spindle carries laps and grinding wheels. Price, \$30 to \$50, less motor, accessories. Will also hone your fine tools



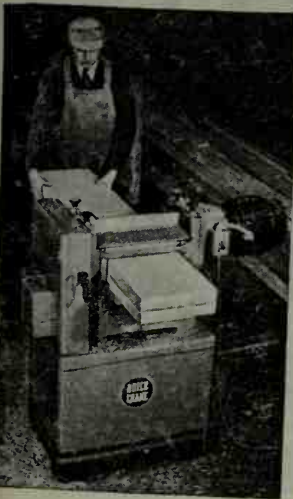
VIBRATING TOOL is relatively a bargain at \$7.50. Easy to use, excellent for marking metals, tooling leather, etching glass or plastics, etc. Has no motor—operates by vibrating coil, which is rather noisy. Accessories include knives, chisels, needles and also ball-point hammers



FLEXIBLE SHAFT is another versatile performer, doing all the work of a hand grinder with easier handling and the ability to get into close corners. Motors range from $\frac{1}{4}$ to $\frac{1}{25}$ hp. Small sizes of $\frac{1}{8}$ to $\frac{5}{32}$ -in. core are popular. Price, \$5 up without motor, \$20 up with a motor

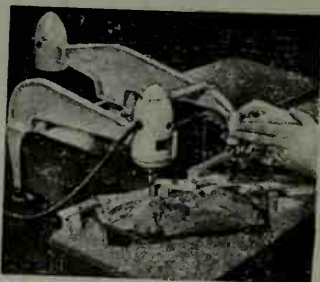


RADIAL SAW differs from a bench saw in that saw moves while work remains stationary. Adjustments and accessories permit routing, dadoing, shaping and sanding as well as conventional cross-cutting and ripping. Available in flexible-shaft or direct drive from $\frac{1}{2}$ -hp. motor

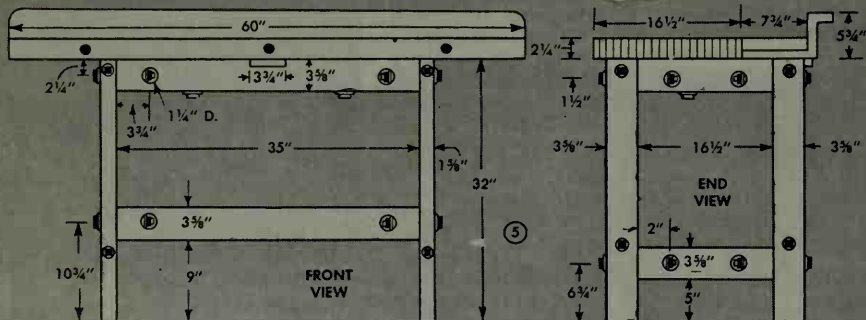
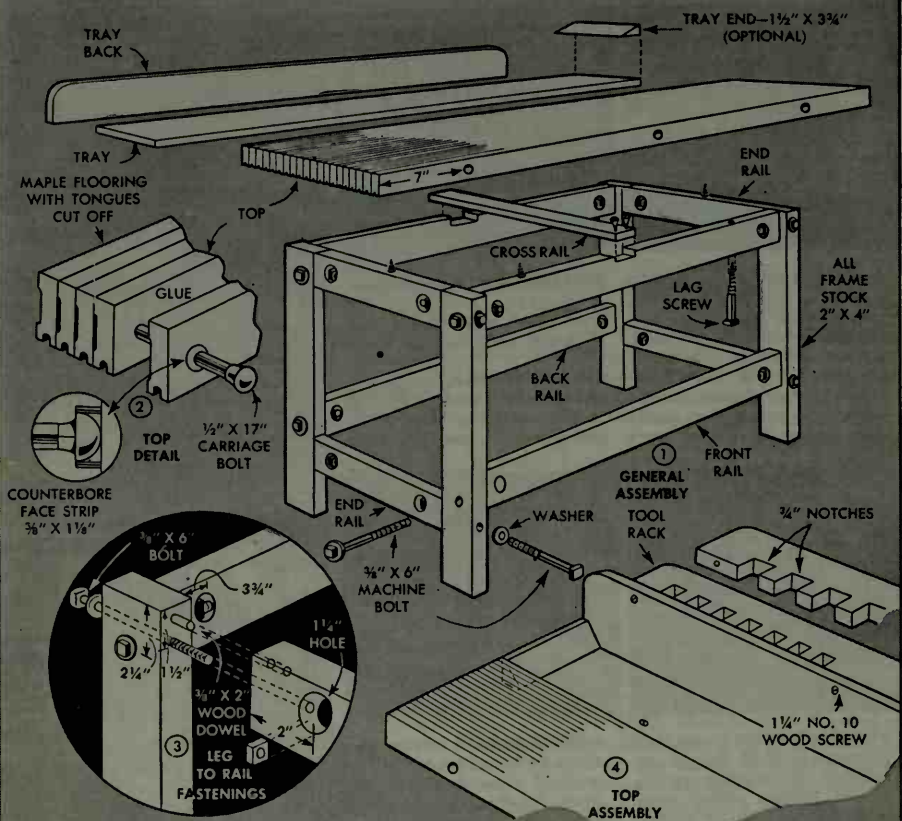


ELECTRIC DRILL is the principal portable power tool in the homeshop. Most popular size is $\frac{1}{4}$ -in. chucking capacity, which ranges in price from \$25 to \$50

PLANER is used for surfacing boards. Popular size handles 4×12 -in. work. Too expensive at \$500 and up for most workshops



DUPLICATE CARVER copies automatically any type of carving placed under the tracing arm. It is excellent as complete hobby tool in itself or as a supplement to regular shop tools. Motor unit can be used as power source for flexible shaft. Price is less than \$50 with accompanying motor. This is a limited, luxury tool



LUMBER LIST (MILL SIZES)

TOP — 11 PCS. ¾" X 2¼" X 10 FT. MAPLE FLOORING
 LEGS and RAILS — 5 PCS. 2" X 4" X 6 FT. YELLOW PINE
 CROSSRAIL — 1 PC. 1" X 4" X 2 FT. YELLOW PINE
 TRAY — 1 PC. 1" X 8" X 6 FT. WHITE PINE
 TRAY BACK — 1 PC. 1" X 6" X 6 FT. WHITE PINE
 TOOL RACK — 1 PC. 1" X 2" X 6 FT. WHITE PINE

HARDWARE LIST

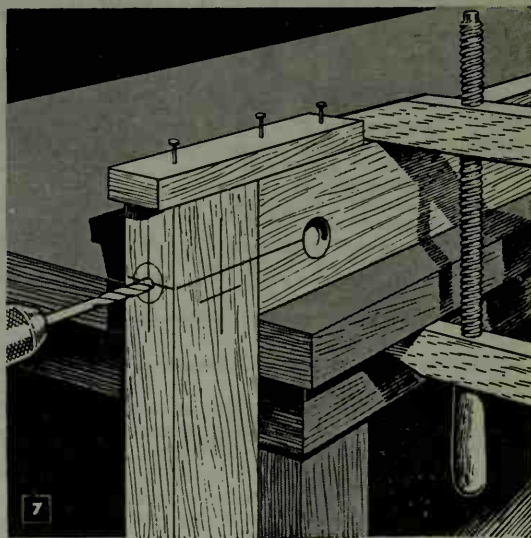
16 — ¾" X 6" SQUARE HEAD MACHINE BOLTS
 WITH WASHERS
 6 — ¾" X 4½" LAG SCREWS
 3 — ½" X 17" CARRIAGE BOLTS
 12 — 1¼" NO. 10 FLAT HEAD WOOD SCREWS
 1 — WOODWORKERS' VISE WITH 10" SAWS

WORKBENCHES *You Can Build*

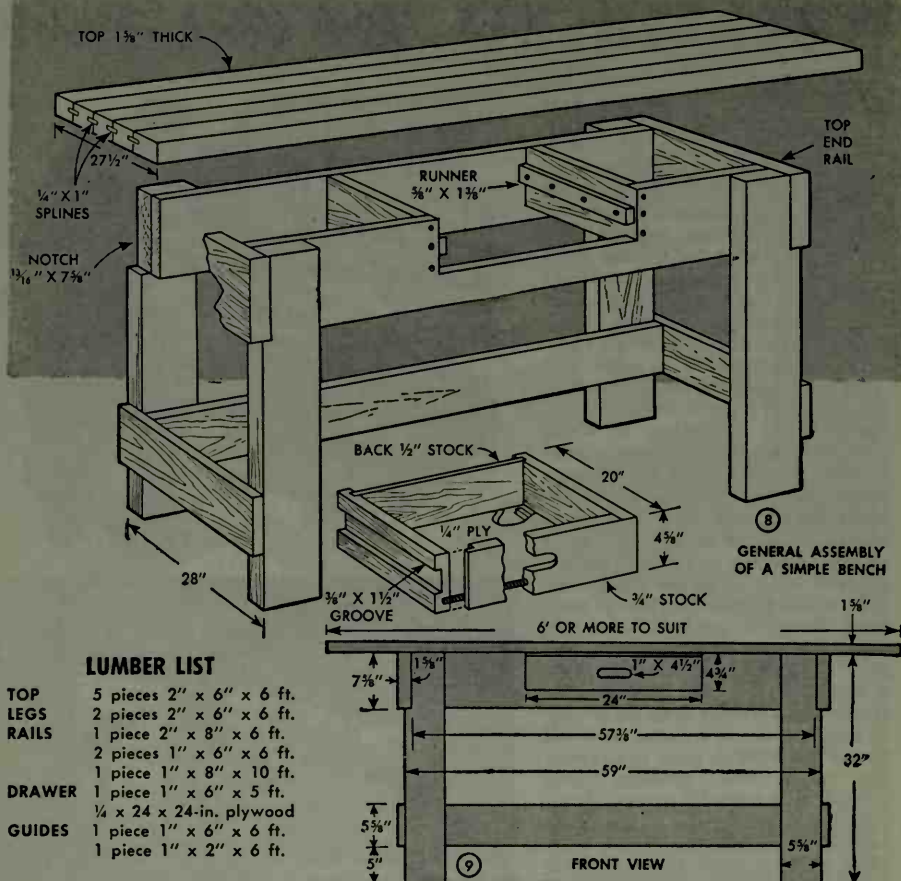
CERTAINLY one of the first things you will need in a shop is a workbench. Since your skill at woodworking may be of no high order at this stage of the game, it is best to make a simple yet sturdy type, reserving the cabinet jobs and streamlining for a later date. A good utility bench is completely detailed on the opposite page. This features drawbolt construction, a style you can knock down in a few minutes if you have to move.

Begin by making the frame. The lumber used is stock building lumber and can be yellow or white pine, oak, or whatever is available in your locality. Cut the various pieces to net length. Carefully mark the drilling lines for the leg-to-rail bolts, as shown in Fig. 3 on the opposite page. Use an expansive bit to drill the big 1¼-in. hole which houses the nut at each joint. Some of the bolt holes can be drilled on the drill press, but others may require working with a brace and bit, Fig. 7. Assemble the two end frames first. As shown in Fig. 3, there is a metal or wood dowel pin at each joint to prevent the wood from twisting. This should be a tight fit in one member, but loose in the other. It is best to assemble the frame with bolts at first, and then drill and fit the dowels. As a matter of fact, the dowels are not absolutely essential and may be omitted if you desire.

The top is made from maple flooring with the tongues cut off. This is an easy job for the circular saw. Next you will drill the cross-holes for the 17-in. carriage bolts. This is a job for the drill press, and you should use a fence and stop block so that every piece is drilled the same. Make a dry trial assembly, then put the whole thing together with glue and the three bolts. The top is fastened in place with four lag screws, as shown. The tray and tool rack are then added to complete the job. Smooth and sand the top to a nice slick finish and give it several coats of floor wax. The rest of the bench can be enameled to match your machine tools or, if you use hardwood, it will look well with a bright shellac, varnish or clear-lacquer finish.



The simplest type of bench construction is a nailed structure with plain butt joints. A design of this kind is shown in Fig. 8. The frame is stock building lumber; the top is made from five pieces of 2 x 6 lumber, with the joints splined and glued, as shown. The top is fitted flush with the front legs, and in this position will leave a little of the back legs exposed on which to fasten a backboard. A woodworker's vise should be fitted to the left end of the top, and the vise should be on hand before you fasten the top in place so that sufficient



projection beyond the end frame can be allowed for mounting.

Workbenches of this style, as well as other designs, can be purchased in knocked-down kit form, ready for assembly. This is an excellent method of building, and the price of the ready-cut parts is but little more than what you would pay for raw lumber.

Probably the most practical type of bench is the cabinet type with drawers, as shown in Fig. 10. Besides providing an ample working surface, this bench has drawer room for all the tools and gadgets which are commonly needed for bench work. A job like this represents a goodly amount of work. But it is all straight sawing and mortising, which is not difficult if you have had a little experience in wood joinery.

As in all jobs of this type, the two end frames are made up first, following the

dimensions and construction shown in the end view, Fig. 12, and details A and C, Fig. 14. This is a mortise-and-tenon, panel-frame construction, with the framing members of stock 2-in. lumber and the panel 1/4 or 3/8-in., 3-ply.

A similar frame, except that it is not rabbeted for panels, is used as a center partition in the framework. This is notched for the top front rail, as shown in the detail at B.

After the three frames have been made, the bench can be roughly set up with the long rails. At this stage you will begin to see the construction and will not have to depend too much on the drawing. Half-lap joints are used to assemble the drawer rails and uprights.

The ends of the drawer runners are stub-tenoned and set into a groove cut on the back edge of the drawer rails, as shown in the detail at D, Fig. 14. The construction

at the back is the same as at the front. It is important that all similar drawer openings be kept the same size so that one machine setup on the circular saw can be used for making all of the 18 small drawers required.

The top is 2-in. stock, which can be assembled with through dowels, as shown in Fig. 13, or bolted or splined, if desired. Drawers can be made with an overhanging lip or plain to suit; they should have at least $\frac{1}{8}$ -in. clearance at each side and at the top.

If desired, the cabinet-type bench previously described can be made up in a shorter model. It makes an attractive small-size if the end frames are spaced about 5 ft. apart, overall measurement. In this case no center partition would be used. The frame would work up nicely with nine small drawers and one long drawer at top, the same as one half of the longer bench shown in Fig. 11.

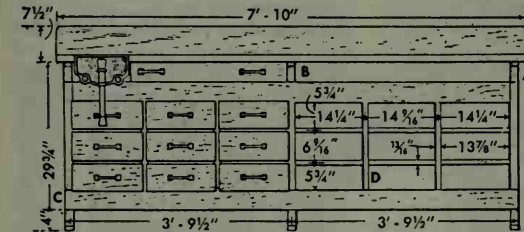
Benches of this type look best if worked



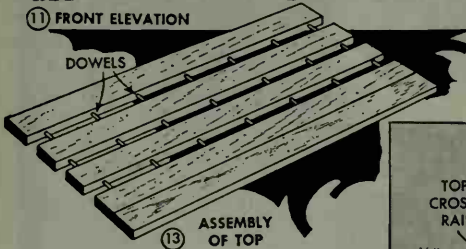
⑩ CABINET WORKBENCH

in hardwood and finished brightly. For that matter, a bright finish would be quite satisfactory on white pine. The softer wood is, of course, much easier to work and has sufficient strength for the purpose. Nothing but select hardwood should be used for the top, however, since this takes a lot of punishment.

Getting back to simpler designs, Fig. 15



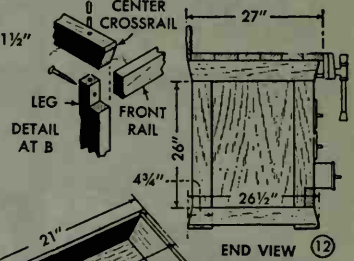
⑪ FRONT ELEVATION



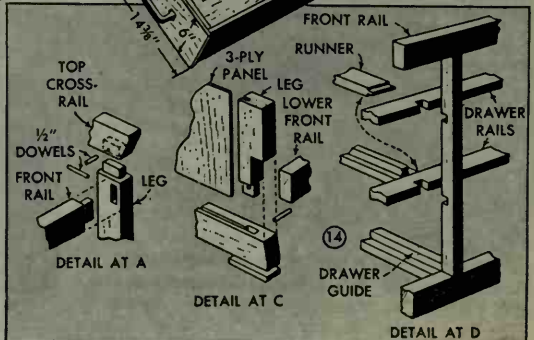
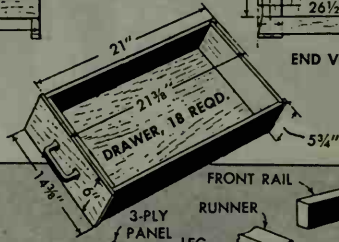
⑬ ASSEMBLY OF TOP

CONSTRUCTION DETAILS OF CABINET WORKBENCH

Pay close attention to the specifications in this construction diagram of the cabinet workbench, since this involves some fairly intricate joinery and a mistake will result in the spoilage of material. Make up the two end frames first, as shown in Figs. 12 and 14, details C and D. Then the bench can be roughly assembled for check of the work



⑫ END VIEW

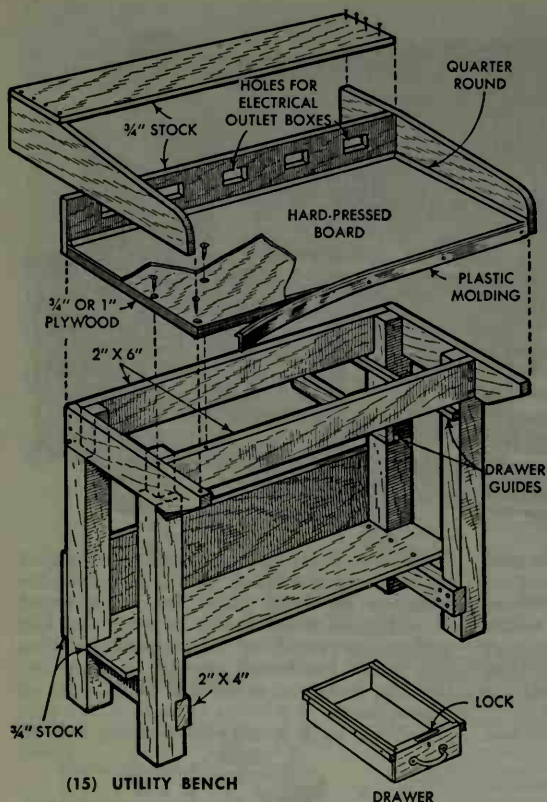


⑭ DETAIL AT A

⑭ DETAIL AT C

⑭ DETAIL AT D

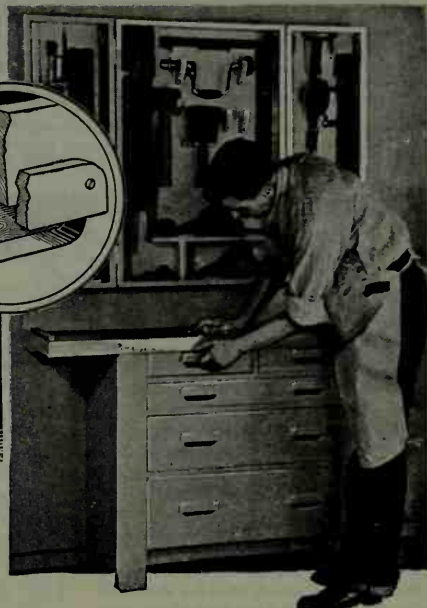
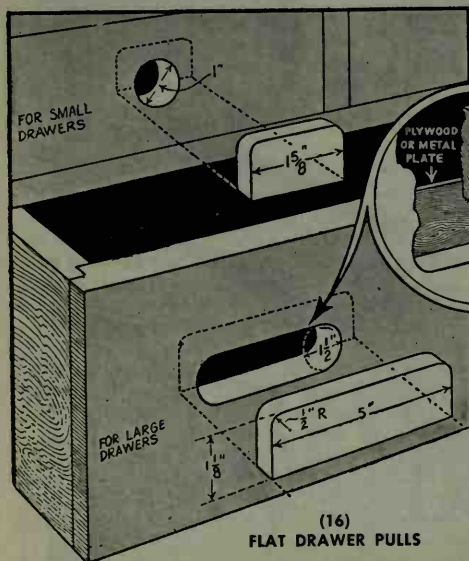
⑭ DETAIL AT B



shows a good utility bench using 4 x 4 stock for the legs. These are cut away on two adjacent edges to take the 2 x 6-in. timbers used for the top rails. The bottom rails are notched into the inner side of the legs, as shown. Parts are joined with waterproof glue and 3 1/2-in. No. 14 flat-headed screws. A lower shelf can be provided as shown, with or without a backing board, or arranged in any other manner to suit your needs.

Neither the top nor the frame is dimensioned for length and width, as the bench can be made any convenient size using the same plan of assembly. In a small size, a 3/4-in.-plywood top is satisfactory, but if the top is longer than 60 in. or wider than 24 in., 1-in. plywood or heavier should be used. The top is screwed in place before being covered with the 1/4-in. hard-pressed board. This is put down with linoleum cement. The front edge is covered with plastic or metal trim, while the remaining edges are fitted with quarter-round strips butted against the side pieces.

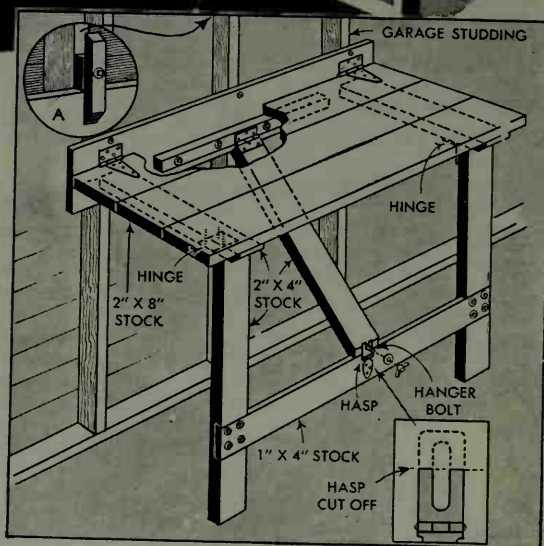
Flat drawer pulls of the type





shown in Fig. 16 are excellent for workbench drawers. All you have to do is cut a hole in the front of the drawer big enough to admit three or four fingers. For a small, light drawer, a single hole to admit one finger is usually sufficient. The wood strips covering one half of the hole are not essential, but they do help to keep out dust. If it is desired to make the opening dust-tight, a strip of sheet metal or thin wood can be applied to the inside of the drawer.

Under certain circumstances, you may have to resort to a folding type of workbench, as for example if you have an auxiliary workbench in the garage. The style shown above will be satisfactory and, when folded, will be completely out of the way. The back of the bench, which is 2 x 8-in. stock, is screwed to the studding, and a brace for the top is screwed to the back. As can be seen from the illustration, the top and the front legs are hinged in such a manner that the top folds against the wall and legs fold against the top. The bench is held in the closed position by a cleat, A, that is screwed into the studding. The diagonal brace which extends from the back to the horizontal cross member bracing the two legs is hinged at the back and connected to the cross member with a hanger bolt and hasp. The hasp is cut as indicated in the lower right detail. Square-headed bolts fasten the horizontal brace to the legs. As a light,

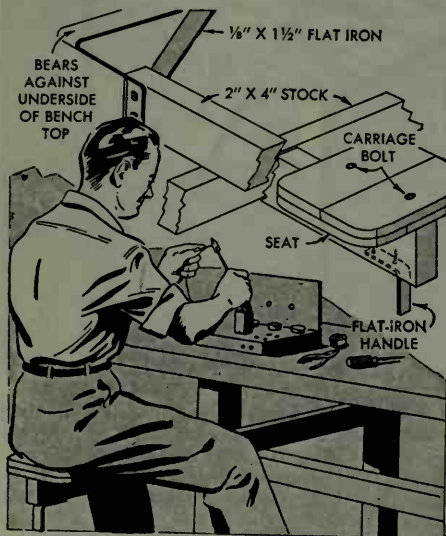
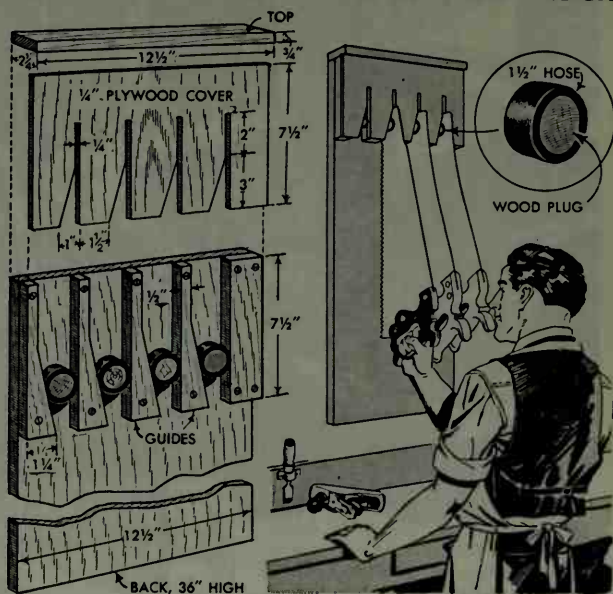


foldaway bench for the basement, this unit can be used to good advantage as a drawing board or finishing table.

Most benches are commonly used in connection with a tool panel. It is important that the tool panel be kept separate from the bench. The reason for this is that when you hammer on the bench, you will cause vibrations in an attached tool panel which may dislodge tools. This is particularly troublesome if the tool panel has a narrow shelf holding small cans of paint or loose tools. Some of the designs shown have an attached panel or backboard, but the separate panel is the best. A $\frac{1}{8}$ -in. space is enough between bench and panel—all you need to do is break the contact.

"Rubber-Tired" Rollers Hold Saws in This Rack

When hung over the workbench, it is nearly as easy to replace the saw in this rack as it would be to lay it on the bench. While holding the saw by the handle in a natural position, you simply push the end up into the slot where a rubber-covered roller grips it firmly. A saw is removed by a slight upward and outward motion. The rack can be made to accommodate as many saws as desired, and consists of a plywood cover slotted at the lower edge as indicated. The rollers are slices cut from large hose and fitted with wooden plugs.

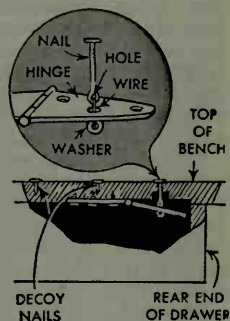


Seat Fits Under Bench

Here's a seat for your bench that is ready when you want it yet out of the way when not in use. The support is a 2 x 4 running the length of the bench. The seat is 8 x 12 in. and is bolted to another 2 x 4. A triangular piece of flat iron bears against the bench top to support the unit.

Hinge Serves as Secret Lock On Workbench Drawer

This simple drawer lock defies detection mainly because it is hidden and also because the nail which operates the lock appears to be one of those used to fasten the bench top to the legs. As the detail shows, the lock, consisting of a strap hinge with a nail release pin



attached to one leaf, is recessed into the underside of the bench over the drawer. One leaf of the hinge is screwed flush in the recess and the other leaf is left free to swing downward to form a stop, which prevents the drawer from being pulled out. The nail release pin is attached loosely to the hinge with wire and a washer. Should the nail become detached from the hinge, a shallow notch cut in the top of the drawer in line with the hinge at the time the lock is installed, will provide clearance so that the drawer can be withdrawn. Several decoy nails should be driven where shown.



Apartment WORKSHOP

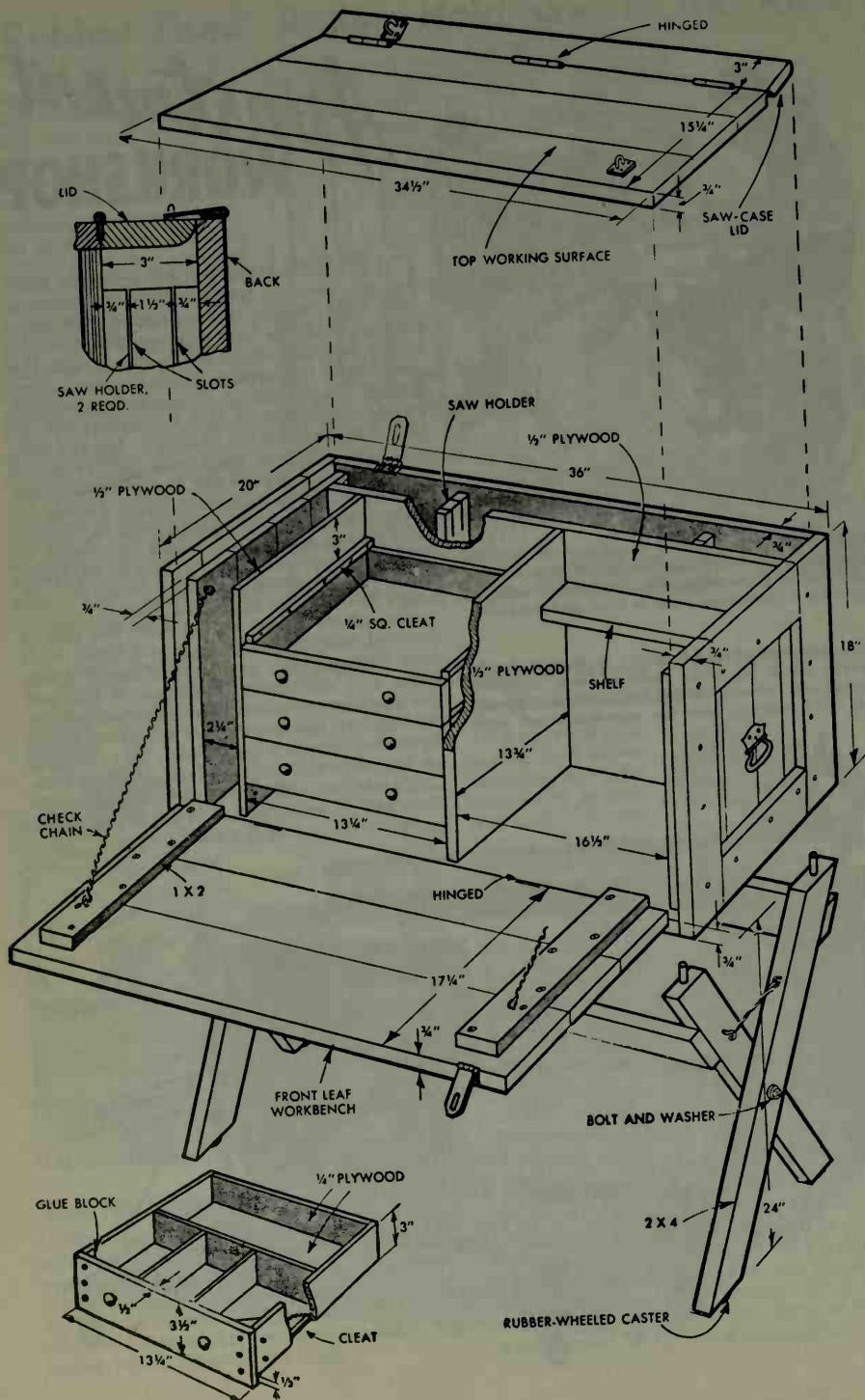
DOES THE kitchen table serve as your workbench, much to the annoyance of your wife? If so, this article is especially for you. It shows how you can have a workbench and tool chest all in one within the confines of a compact trunklike box. Supported by a folding detachable sawbuck stand, both parts of this workshop can be stored in a minimum of space. It's the perfect setup for the man who resides in an apartment, or the owner of a basementless house who likes to tinker, build models or keep the household appliances in repair. Everything is at hand when you want to "set up shop" and, when you're through, tools can be quickly packed away for another day. It's as simple as that.

You literally "set up shop" when you roll out this compact little workshop. Combining a chest and bench in one, it's the answer to the apartment "crafter's" prayer for a convenient place to work and store tools

Chain-supported drop lid lowers to form a handy lap-type bench top when chest is open. Compartment at rear affords storage for handsaws, square, level, etc. Drawers care for countless small tools

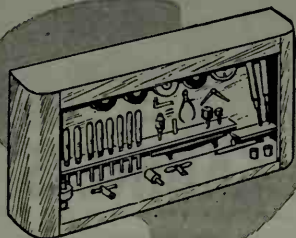
The photo below shows how the box is divided into compartments and fitted with four drawers for regimenting small tools, parts and materials. Features of the box are a separate compartment at the back for storing two handsaws, and a lid that drops down to provide a bench top. The drawing on the opposite page details construction. Crate lumber will do for the box, although pieces of plywood are best for forming the compartments and drawers.



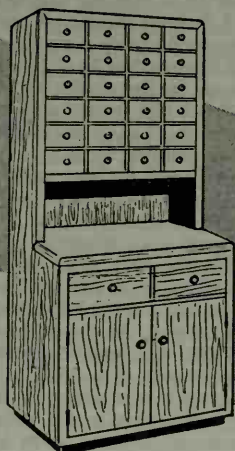




BENCHES



TOOL PANELS



CABINETS



HARDWARE STORAGE

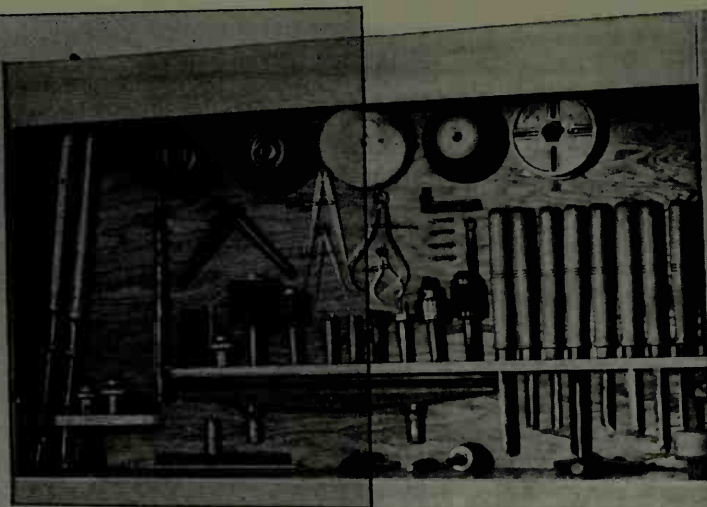


WORKSHOP FURNITURE

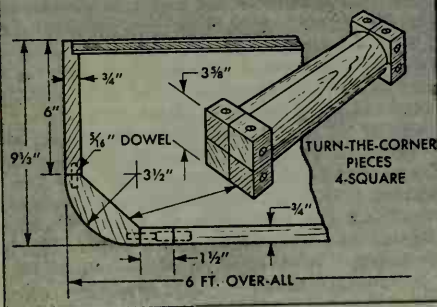
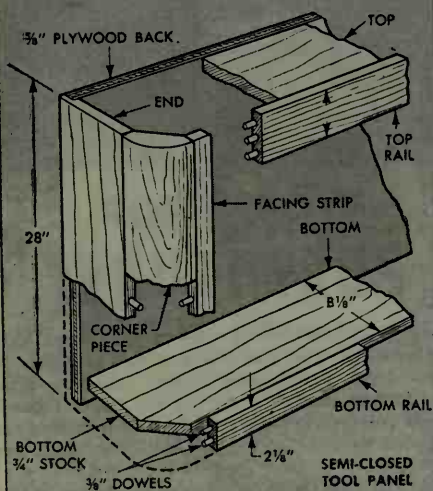
GOOD furniture makes a lot of difference in the homeshop—you can have a raft of tools, but you won't get much done unless machine accessories, hand tools and hardware are housed in suitable cabinets and tool panels. And like other furniture, these pieces should fit into the decorative scheme.

If you will analyze your own or the other fellow's shop, you will find it is not a lot of power tools which make an attractive shop, but rather the tool panels and cabinets. On both counts—utility and appearance—it is almost impossible to overdo this phase of homeshop planning. The only way you can overdo it is to tackle it all at once.

Take your time—you won't be buying a dozen power tools all at once, and neither will you do a really nice job of furnishing until you are an experienced crafter. In the meantime make a place for everything you use, however rough. Then you won't spend half an evening looking for a hammer or wondering where you put that box of 1¼-in. No. 6 flat-headed screws. We'll tell you how it's done on following pages.



TOOL PANELS *and* CABINETS



TOOL PANELS keep pace with your collection of tools, and it is likely that a couple boards of shiplap cleated across the back will do for a starter. A really nice panel can be made from a single sheet of 4 x 6 or 4 x 8 plywood in $\frac{3}{8}$ or $\frac{3}{4}$ -in. thickness. The panel in the photo above might be used without the framing. It shows a typical collection of shop tools and methods used in mounting them.

The plywood used for any panel preferably should be water-resistant, especially if your basement is at all damp. Some ordinary plywood and especially lumber-core veneered sheets have a tendency to come apart when exposed to the humid atmosphere of the average basement shop in the summertime. On the same subject, it is a good idea to cleat the back of the panel so that it sets out a half inch or so instead of being in contact with the wall.

Mounting can usually be made with nails or screws so located as to hit slight cracks or openings between the cement blocks. For a more professional job you can bore holes in the cement with a star or carbide drill and then insert toggle bolts. Four bolts fitted in this manner will hold the average panel neatly and securely. Various types of patented anchors also are available. These hold firmly when driven into suitable holes drilled in the concrete and, in turn, provide a secure mounting for nails or screws. Another much-used method somewhat similar to the patented anchor calls for drilling holes in the

concrete as before and fitting the openings with drive-fit wood or rawhide plugs which take the panel mounting screws.

Assuming you have a collection of tools ready for mounting, the best system is to plan and fit the various units before the panel is mounted. This permits access to the back of the panel, which is often useful in mounting racks and special brackets.

The simplest tool mounting is the familiar pair of nails. However, you can do the job much more neatly with wood or metal dowels. Usually you will have one or two racks with holes or slots. The rest of the board depends on your own tools and your own layout ideas.

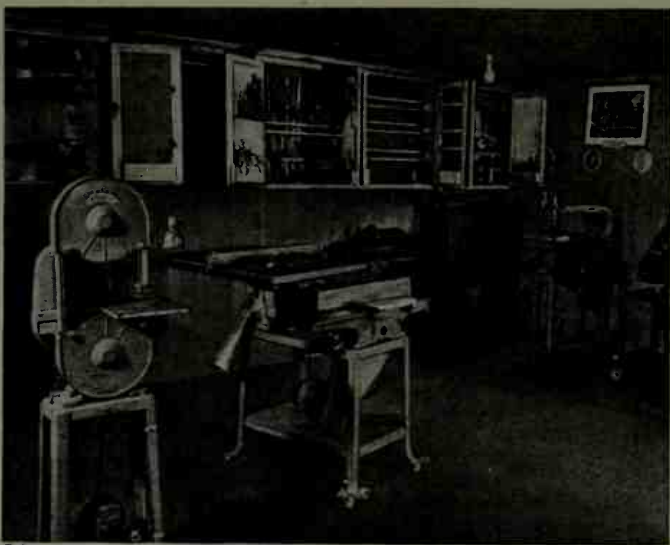
The panel will be clean and stay clean if you sand it smoothly and give it a coat or two of shellac or paint. This should be done before the board is cluttered with pegs and racks. Consider lighting and wiring—quite often a fluorescent tube over the panel sets it off, and certainly a bench tool panel can stand a couple of outlets.

Half-round or back-band molding nailed to the edges takes off the raw appearance of the plywood edge. The back-band molding is the more attractive of the two. You can buy this at any lumberyard handling trim lumber. Gum banding around a birch or fir panel gives a two-tone, light and dark effect which is pleasing.

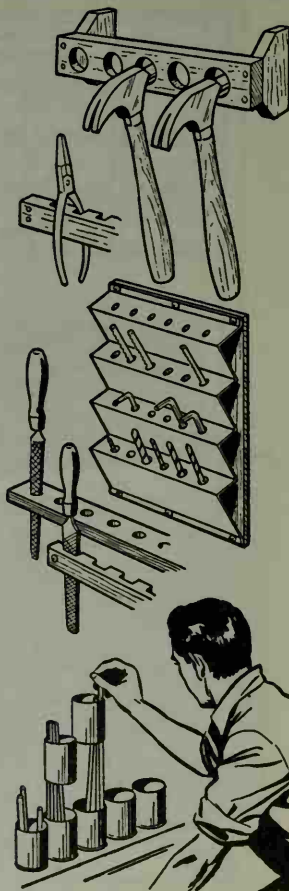
Panels in walls: If your shop has a wooden partition, good use can be made of the space between the walls, as has been done in the shop illustrated above. The same idea can be worked in new construction by erecting a dummy wall in front of the old wall.

If your shop is in the basement, the wall selected for this should be an inside surface in order to eliminate possible dampness. This applies especially to cabinets consisting of a face and shelves only, no back. In most basements there are suitable areas around the chimney or under the stairs which can be blocked off in this manner, using just a front or front and end and allowing the existing walls to make up the rest of the shop enclosure.

Semi-closed tool panel: The partly enclosed tool panel is somewhat neater than a plain panel and offers better protection from rust and dust. This construction is not suited for a bench tool panel because of the overhang, but it makes an ideal installation for the lathe, shaper or drill press. A typical job is shown in the photo at the top of page 76, and the construction is shown in the drawings at the left. Most of the work is done on the circular saw, with the exception of the



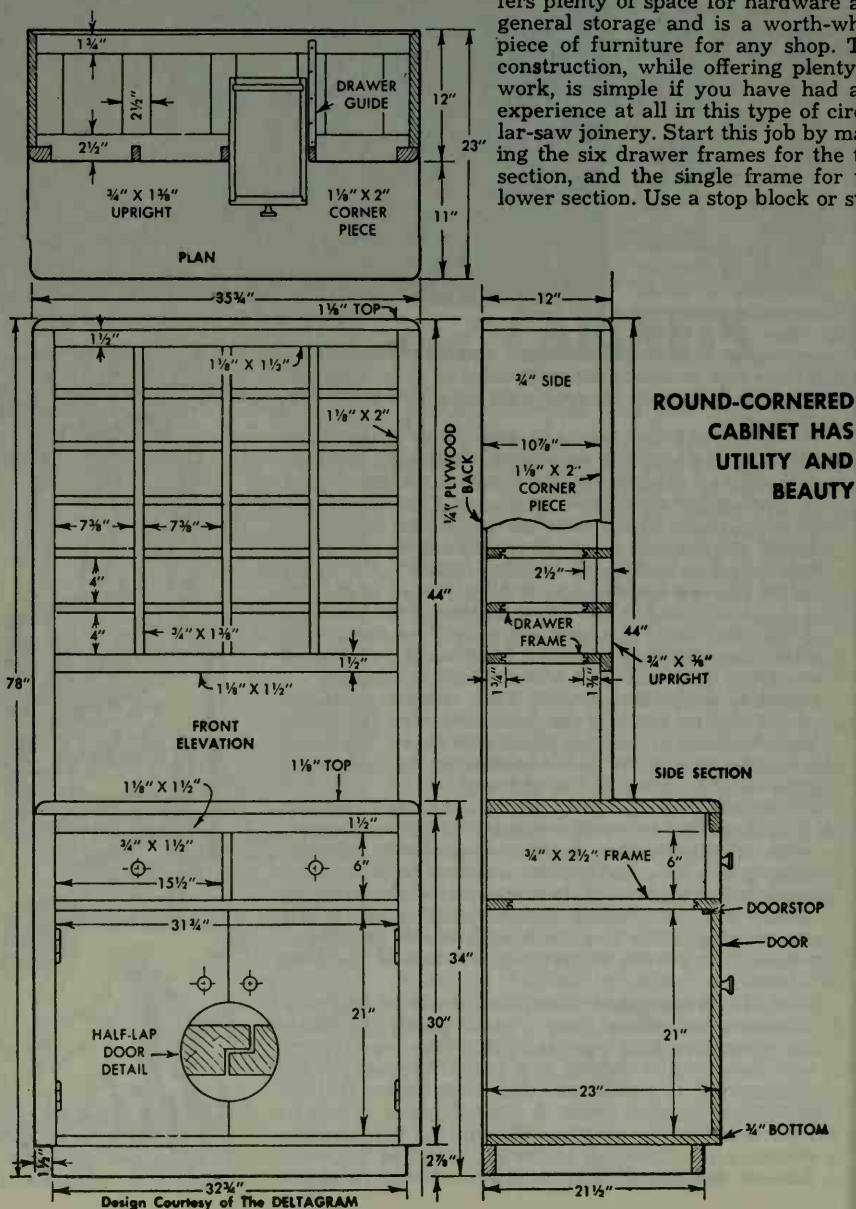
Delta photo



rounded corner pieces which are turned up four-square in the lathe. Excess wood at the ends allows fastening for turning and also provides a square base for the doweling operation. The $\frac{5}{8}$ -in.-plywood back should be fitted with the necessary racks and pegs before the assembly is made. A unit of this kind is nice with a fluorescent lamp across the top fitted to the back

of the top rail, or a pair of lamps fitted to the backs of corner pieces. Filament lamps either regular socket, tubular or lumiline can be used and have the advantage of more heat, which is useful in evaporating moisture from the surrounding air.

Round-cornered cabinet: Rounded corners will give any cabinet a more attractive, modern appearance. The design shown offers plenty of space for hardware and general storage and is a worth-while piece of furniture for any shop. The construction, while offering plenty of work, is simple if you have had an experience at all in this type of circular-saw joinery. Start this job by making the six drawer frames for the top section, and the single frame for the lower section. Use a stop block or stop

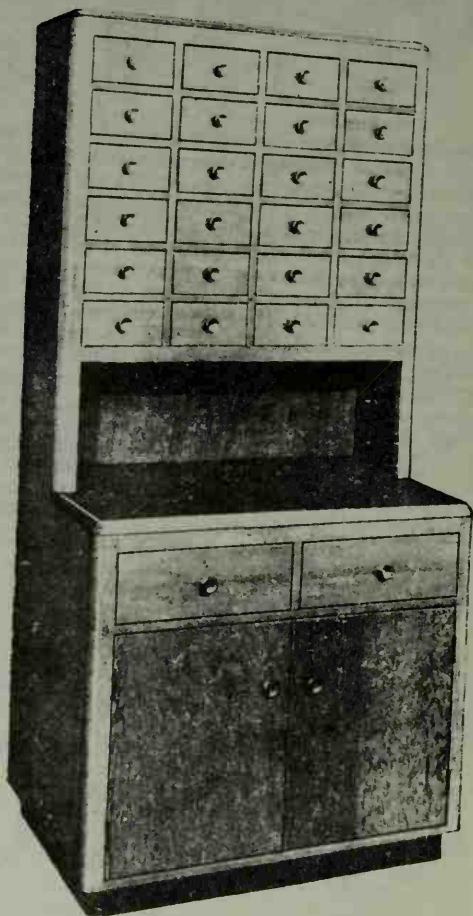
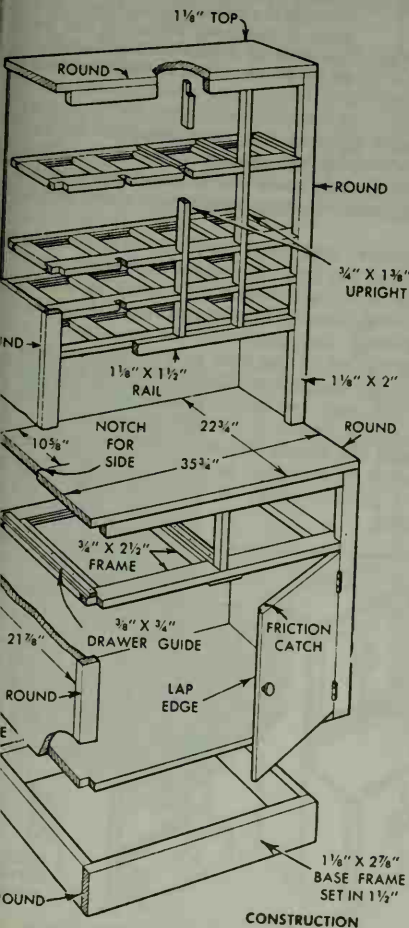


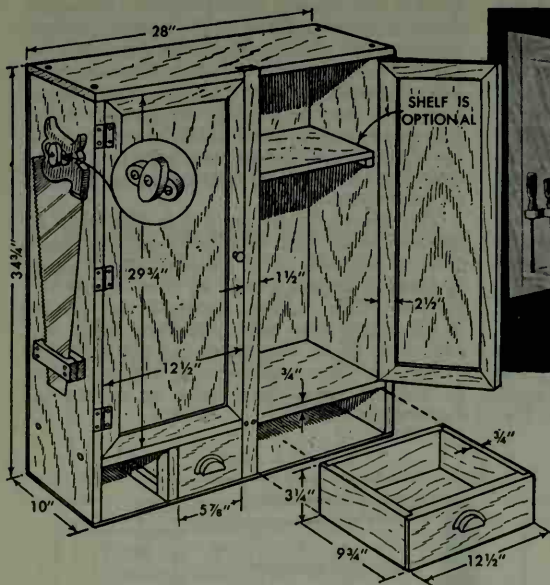
rod when cutting identical lengths, and use a fixed setup for all other circular-saw work involving duplicate cuts. Sides are made up next and nailed to the $\frac{1}{4}$ -in.-plywood back, after which the drawer frames can be fitted in place. As shown in the drawing, the frames are simply butted in place and held by nails, but it would be worth-while to groove the sides about $\frac{1}{4}$ in. deep to provide housed joints. Another alternative would be to nail cleats to the sides to support the drawer frames; this does not interfere with the drawers and will not affect the dimensions as given. Other parts are added in whatever order you like.

All of the corner members are given a $\frac{1}{2}$ -in. or larger round, running the work on the circular saw with a molding head or on the shaper with a shaper cutter. The

base is the modern setback type. Doors are $\frac{3}{4}$ -in. plywood, fitted with bullet friction catches and closing on a shiplap joint, as shown, for a good dust seal. The drawers are conventional construction, using $\frac{3}{4}$ -in. stock for the fronts and rabbeting to take the $\frac{1}{2}$ -in. sides. Care should be taken in building the cabinet to get all drawer openings the same size so that any drawer will fit any opening.

The nicest finish on a job like this is natural wood with two coats of clear varnish or lacquer. With this in mind, maple or birch plywood would be first choice for the sides. The cabinet shown in the photo is all white pine with finishing nails set and holes filled. The finish is light with the exception of the setback base, which should be painted some dark color so as not to show scuff marks.





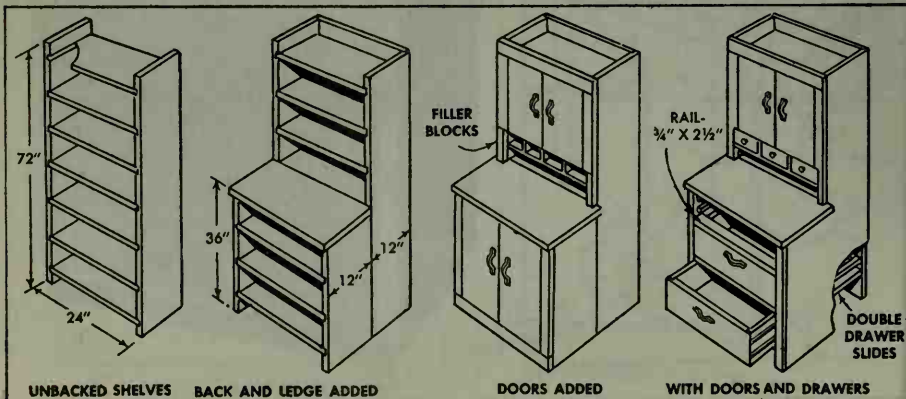
Shown here is a small, fully enclosed tool cabinet which is ideal for the beginning home-workshop proprietor. It will hold the initial supply of tools, and when it has been outgrown, can be converted to a handy storage cabinet for hardware and other workshop items

Standard cabinets: The stock design for a fully enclosed tool cabinet is something on the order of the unit shown at the top of this page. This is a good size and style of cabinet to make for a starter—it holds your starting collection of tools and later on can be converted into a hardware storage cabinet. The doors are mitered at the corners and grooved all around to take a 1/4-in.-plywood panel. The rest of the construction is plain butt joints. For doors, 3/4-in. plywood can be used. Besides looking better, plywood simplifies the building.

Plain cabinet construction in larger sizes is well-illustrated by the series of drawings below. The base unit is made from stock 1 x 12 boards, grooving the sides to take the shelves, as shown. A plywood back can

be added by rabbeting the sides or can be simply butted between the two sides. The second sketch shows a bench-height unit added, with the top overhanging about an inch.

Further additions and variations are shown in the two right-hand sketches. Any of the units will make up nicely in white pine with simple butted and nailed joints. If desired, the shelf can be mounted on cleats nailed to the side pieces rather than using the housed joints shown. A cabinet like this can be made quite attractive if face strips about 2 in. wide are added to conceal the cleats. Avoid knotty white pine for shelves unless it is hand-picked—large knots in the center of a board will cause sagging.



IF WORKSHOP AREA is limited, especially when it comes to convenient storage, you will want this little roll-away shop cabinet. Mounted on four casters, it is moved effortlessly wherever desired and tucked away in a corner when not in use. Sides of the cabinet consist of storage doors which swing outward for easy selection of small parts.

Although the original cabinet was designed purely to hold small parts and used in addition to other shop facilities, the cabinet can be adapted to serve as a self-contained shop by fitting one or both doors as tool panels and using the inside shelves for the small parts and supplies. When the doors are used for small-parts storage, as detailed, two types of racks or bins are mounted on them. One door is fitted with slanted shelves for boxes of bolts, screws, etc., and the other door is lined with rectangular cans for holding unpackaged parts.

The doors are held closed with a pair of self-locking latches cut and bent from sheet metal. Each latch is drilled, slotted and notched, and then pivoted to a door with a bolt or screw. A second screw driven through the slot holds the latch in locking position, while the notched end of the latch engages a screw driven into the cabinet front.

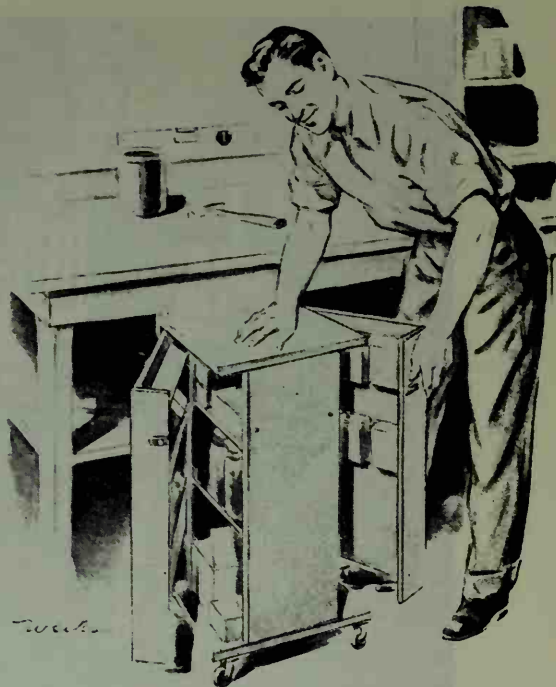
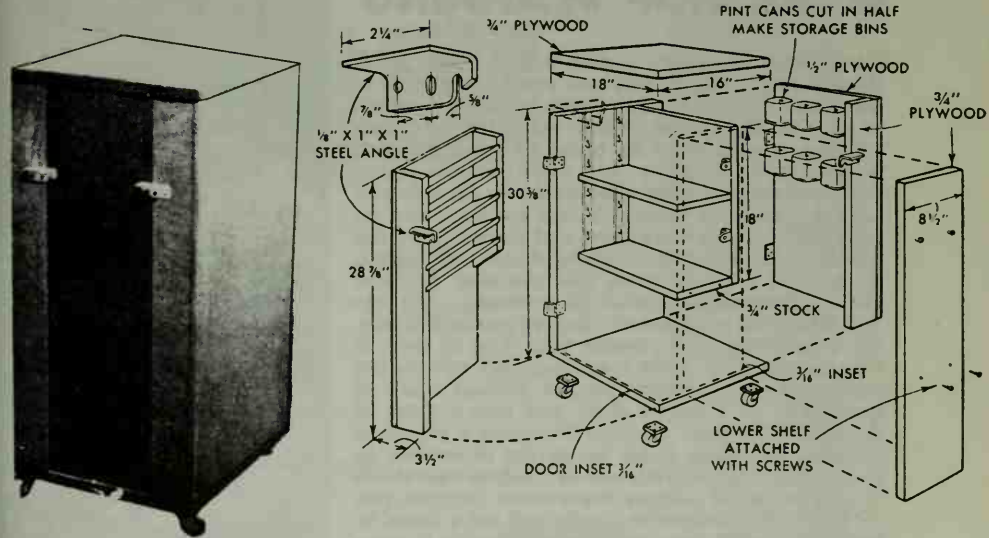
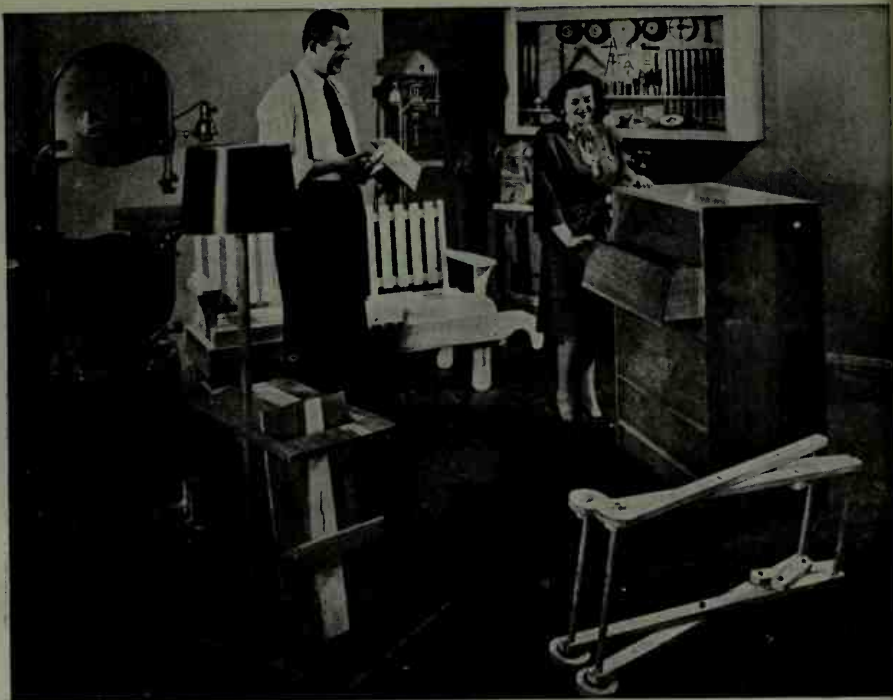


Illustration above shows how the sides or the rolling cabinet swing open for easy selection of small parts





WORKSHOP PLANNING

YOUR HOME WORKSHOP begins with a plan. Even though you purchase only one small power tool at the outset, there must be a bench or stand on which to place it, there must be floor space for the bench and also space around the bench or stand in which to operate the machine. And there you are—space and place come first, then the machine. Already you have a plan, even though it may not be drawn on paper with all the work areas and placement of the power tools calculated and dimensioned beforehand. It must be a casual plan, like the shop pictured above. Homeshops cannot be arranged with the dull, blueprint precision of a factory production line. There are very good reasons why. One of them is that the schedule of the homeshop may call for the making of a one-evening project, such as a pair of book ends or a simple shelf, and also a chest of drawers to be done in spare time over a period of months. Obviously then, the saving of seconds in the handling of materials and in machine operations is not a matter of primary importance. Suppose you do take a little longer to handle and cut a board to length and width than would be permissible in commercial shops where minute multiple savings in time add up to a lot of money earned. It's your own time, isn't it? And nobody's paying you for it.

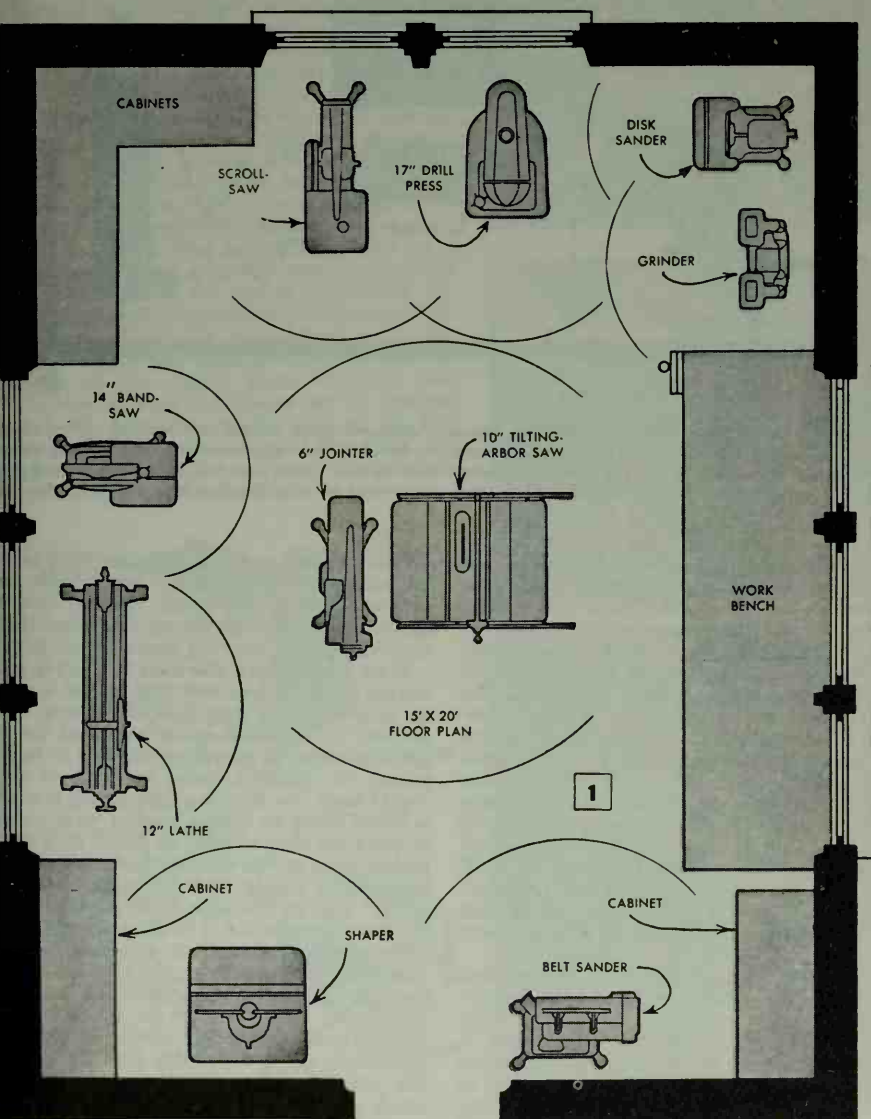
"Home workshop" is just another name for a recreation room. Tight production schedules have no

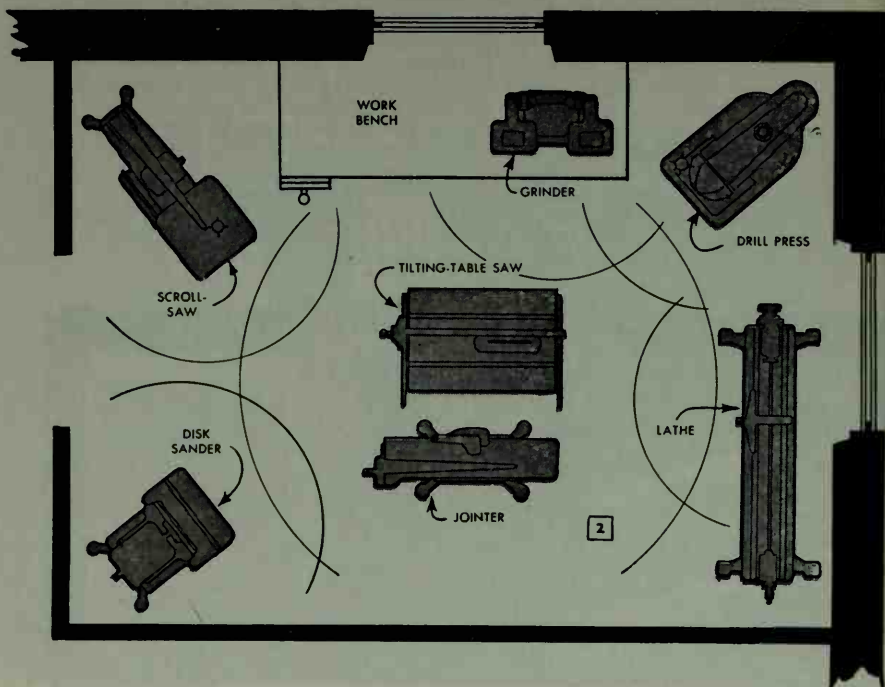


place in it. Rather it's a place for relaxation, a place for planning new and interesting projects, a place for learning new things about the operation of small power tools. The shop pictured on page 5 illustrates the point. Study it carefully and you won't see much evidence of a calculated plan. Of course, the lathe has been placed under an accessory cabinet, the drill press has been canted in a corner where it usually belongs, there's a bandsaw out on the floor where there's plenty of room all around it and it's certain there's a circular saw

around somewhere. All this is just part of a casual plan, a corner of a homeshop in a basement, clean and neat as a pin. But the projects pictured show that work, craft-work, is done in the shop. Another important thing about this picture is that there are two people in the shop who give every evidence of thoroughly enjoying themselves.

Shop space available is one thing that's important in planning a homeshop. Compare the plan in Fig. 1 with the one in Fig. 2 and you'll see that the first floor plan is





Scribed arcs on the plan above represent the minimum allowable space around each machine. When areas overlap, total working space will be somewhat restricted. However, this simple method will help you arrive at the space required for a given number of machines. Just make a rough plan and scribe arcs around the machines on the approximate radii given below. Note unrestricted space on the shop plan detailed at the left

comparatively spacious while the other places the maximum number of power machines in the minimum of floor space. The curved lines drawn on the plans indicate the minimum working area required about each machine. In the plan above note that the working areas overlap. Wherever the working areas overlap, the general convenience and workability of the shop will be restricted proportionately. A reasonably accurate rule to follow when laying out a homeshop on paper is to allow space representing 36 in. in front and on both sides of machines that can stand against the wall. Such machines include the drill press, lathe, sander, shaper and grinder; also the bandsaw, with some exceptions. Allow a 48-in. working space around a circular saw and jointer for good measure.

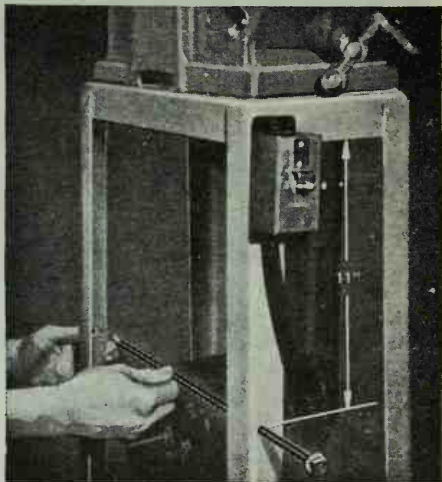
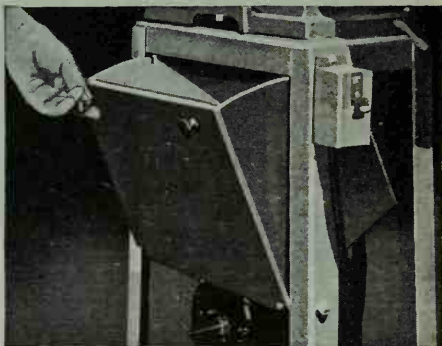
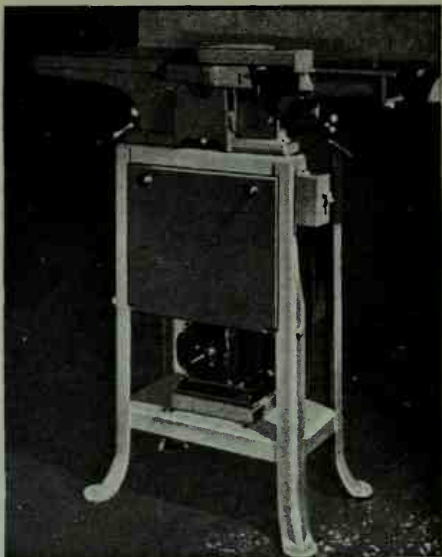
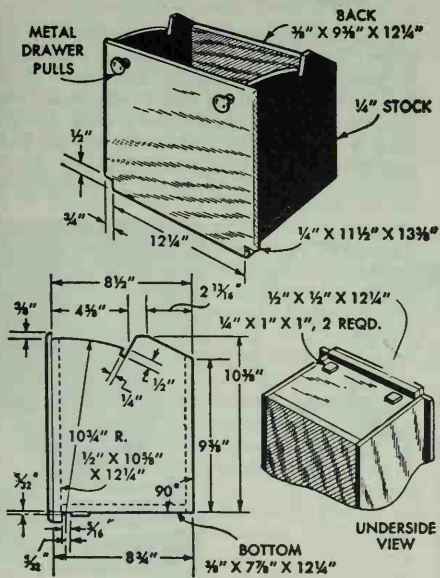
It should be understood, of course, that this is not a precise and orthodox procedure. Neither does it cover every contingency. For example, in the plan in Fig. 1, should you have to drill holes at the center of a long piece of stock you would have to move either the drill press or the scrollsaw. Some home craftsmen mount power tools

on heavy casters or dollies so that they may be easily moved about the shop. Such an arrangement is especially handy where space is restricted. However, you'll find that this method of figuring space saves time.

Now, if you draw the plan to a fairly accurate scale of the room you intend to use as a shop, you can quickly figure the amount of working space required for a given number of power tools. Try to have plenty of working space in front of the workbench, for here's where you'll precut a lot of stock to rough lengths with hand tools. One should keep in mind also that power tools in the popular homeshop sizes have work tables that are comparatively small. The largest saw table practical for the homeshop is about 36 in. wide with the table extensions, or grids, attached. Other machine tables are much smaller. The average homeshop bandsaw has a table measuring about 14 x 14 in. Stock longer than 48 to 60 in. in length cannot be worked effectively on tables of this size. However, the maximum length of single pieces of stock used in the average cabinet seldom exceeds 60 in.

WORKSHOP PLANNING

DISPOSAL of light, fluffy shavings from a jointer is aided by this neat shavings box. As pictured at the right, it works just like a tilting flour bin and is easily removed from the jointer stand for emptying, thus keeping the shop clean and reducing the fire hazard to the minimum. The back, bottom and sides are made from plywood and the front from solid stock. Note that the upper ends of both sides are cut part way across the width on a 10¼-in. radius, the curved cuts ending in ¼ x ½-in. notches. The back sides of the notches form stops. The front piece is rabbeted on both sides and the lower corners are notched as shown. In assembling, the joints are fastened with glue and small nails or screws. After assembly, a cleat is nailed and glued to the bottom as in the underside view, below, and two small blocks are glued to the bottom in the position indicated. The box is supported by a 5/16-in. metal rod as in the lower right-hand photo. To place the box in position in the stand, slide it inward on top of the supporting rod. Then tilt it outward until the stops strike the vertical sides of the top piece of the stand. Then raise the box slightly so that the blocks on the bottom will slip over the rod. To remove the box simply tilt it outward until the stops engage the stand. Then raise it slightly and pull outward at the bottom.

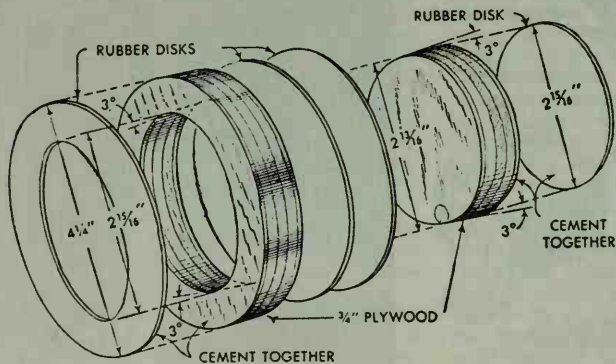




Test power tools for vibration with a full glass of water. If none spills over with power on, you've got the problem licked

NOISE is one of the minor nuisances of the homeshop, and what you do about it is largely dependent on complaints from other members of the household. Of course, there's no sense in having the place sounding like the hammers of Hades, so you should employ a little direct action to hold it to a minimum.

You can make almost any machine less noisy. You do it by eliminating vibrations. A beautiful and simple example is the bandsaw; work it on three legs on a rough floor and it will clank like a slow freight; give it a shove to ride level on all fours and it will be as quiet as anything. A like, but more complex, problem is a metal lathe,

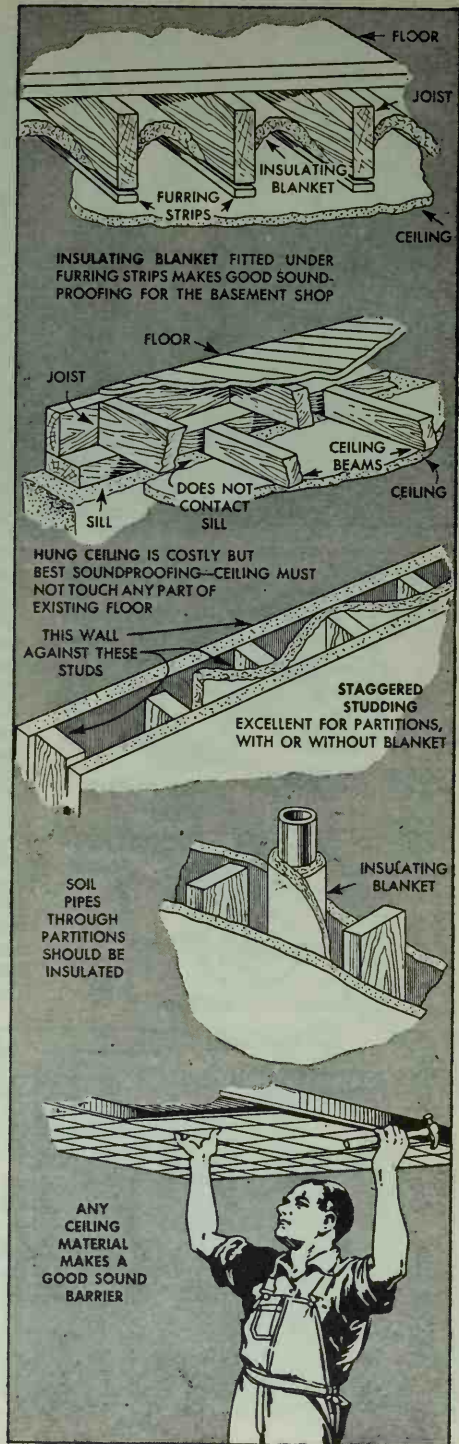


PLANNING

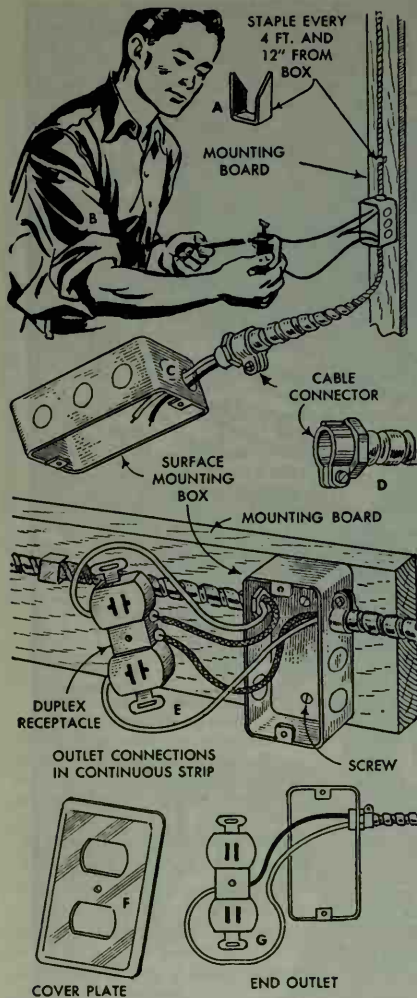
which can be made a smooth-running, quiet performer if you go over it carefully to see what rattles. Tight belts on motors are often the source of an annoying, thudding noise—check every machine at this point, especially if you use a floating drive. All machines which tend to rattle should be cushioned on rubber. A good insulator for this purpose can be made from two nested rings of plywood with rubber sandwiched between, as shown in the drawing on the opposite page. Rubber heels can be bolted to stand legs. A compressor can be silenced to a weak pop by mounting it on springs of old inner tube. Cushions are not satisfactory on machines which must be moved frequently, and in this case the insulation should be applied between machine and stand rather than stand and floor. Insulating both points is good practice—the jigsaw on the facing page is rubber-mounted on the stand and is cushioned again at the floor.

A third noise eliminator is the simple business of closing the basement door—but right! A double door is better if the arrangement of your shop permits. Anything else you do in the way of soundproofing comes under the heading of new construction. Several ideas are shown in the drawings at right and are self-explanatory. The problem to lick, of course, is the ceiling, especially if it is a single thickness with plenty of ventilation. You can make a world of difference in the volume of noise that filters upstairs by installing any kind of ceiling in the basement shop. There are many kinds of building boards provided for this purpose, some of which are sound absorbers as well as sound barriers. A new ceiling can be further soundproofed by using an insulating blanket in the manner shown at top of the drawing. A hung ceiling—as in the second sketch—is supposed to be the very best in soundproofing, but obviously takes a bit of work. Staggered studding, which is the same idea, is more practical and can be installed where needed.

If your shop is in the attic or similar location, the soundproofing is, of course, concerned with the floor. A fair job can be done by simply cushioning all machines on squares of 1-in. insulating board. For a really good soundproof floor, a subfloor of 1-in. insulating board should be put down. Over this is placed 1 x 2-in. strips, nailed through to the wood underneath. On top is laid regular flooring covered with linoleum. This makes a barrier, an absorber and a dead-air space, all of which combine to reduce noise to the minimum.

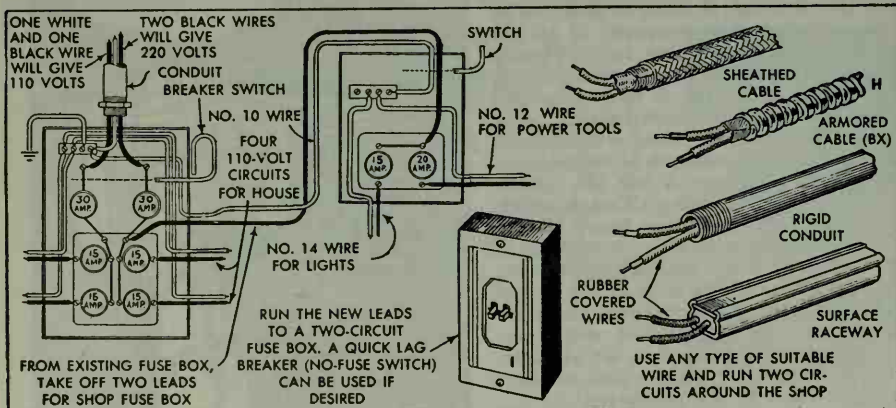


WORKSHOP WIRING LIGHTING



IN THE BEGINNING, the average crafter has no need for special homeshop wiring—you start with one or two power tools and you plug them in at existing outlets. As your shop grows, you will start using two-way plugs, then three-ways, until finally the whole thing is a headache and you decide to do the job right.

Wiring a homeshop is fairly simple and demands only a little common sense. The general idea is to run in two new circuits, one for the lights and one for the power tools. The double circuit avoids possible dimming of lights when motors are switched on and also maintains the lighting system if you blow a fuse on the motor circuit. The starting point for the new wiring is at the existing fuse box. This may be any of a dozen different styles, a typical box being shown in the left corner of the diagram on this page. This is a three-wire power supply for 220 volts, but is used only for four 110-volt circuits. The new circuit is run in with No. 10 wire, running the white wire from the ground bar, and the black or "hot" wire from any convenient point beyond the main 30-amp. fuse, as shown. This power line runs to a separate two-circuit fuse box or you can use one of the popular quick-lag breakers. A breaker is a thermal switch which snaps off when the wires get too hot—you correct the cause for the "blow" and then reset the switch. The proper size of breaker to use is a two-circuit with one line set at 15 amps. and the other at 20 amp. The 15-amp. circuit is used for lighting, and is run in with No. 14



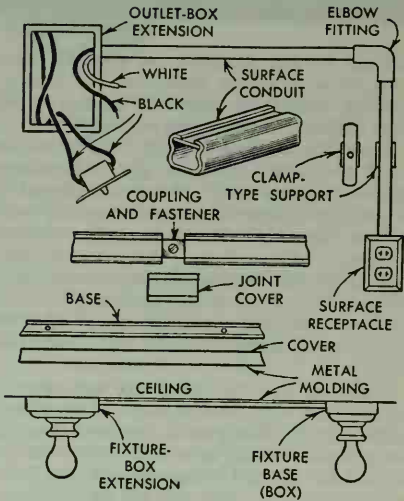
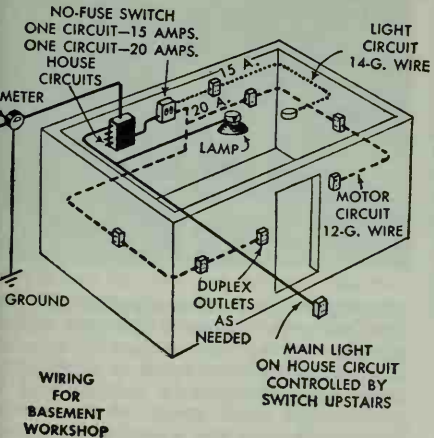


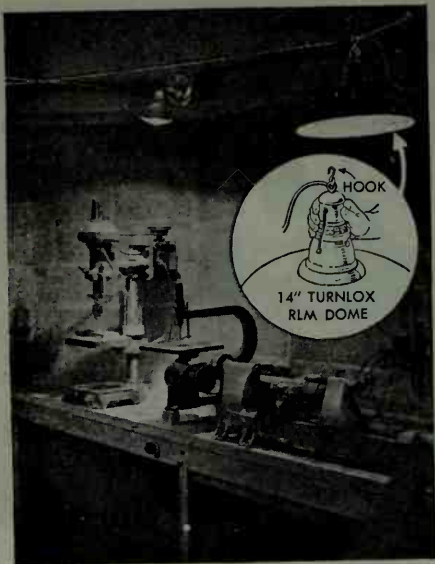
Ceiling globes and reflectors provide this shop with excellent lighting. A special feature is the trolley duct, which allows moving outlets. The diagram at the right shows wiring details of a surface raceway

wire. The 20-amp. motor circuit uses No. 12 wire.

Wiring cable can be any of the styles shown on first pg. Sheathed cable is popular and is easiest to install, but other types are more permanent and much neater. The surface raceway makes a neat job of conveyance. This can also be obtained in convenient lengths from 1 to 5 ft., ready-wired, and with built-in outlets every 6 inches. A trolley duct, as shown in photo above, allows the various lights or receptacles to be

Plenty of outlets are provided in the basement-shop wiring setup diagrammed below. Photo at lower right shows corner of a shop wired in this fashion





General Electric photo

pushed to any position as needed. However, most crafters settle for the less-expensive sheathed cable or armored BX, plus duplex receptacles as required.

In all homeshop wiring, whether using rigid or metal conduit, the structure of the room determines to a great extent the procedure followed. Usually there is a way to feed flexible conduits through or around ordinary obstructions, but sometimes it will be found impossible to run conduit to certain locations. Such situations call for surface conduits, sometimes called metal molding, as shown in the right-hand diagram.

Lighting can be direct or indirect, incandescent or fluorescent. The average shop usually features a combination. The main light should be a 150-watt bulb, and should be on the house circuit, controlled by a switch at the top of the basement stairs. Other 150-watt lamps can be installed as needed, and should be fitted with suitable reflectors or domes. One of the most popular reflectors is the turnlox RLM dome with a 14-in. dia. for 150-watt bulbs. A 12-in. dome is used for 75 or 100-watt lamps. The turnlox construction permits removal of the reflector and lamp as a unit with a quarter turn of the reflector. The top of the unit can be fitted with a hook so that the lamp may be pushed along a mounting wire.

Fluorescent light is excellent, and two 40-watt tubes in a reflector will give an abundance of light at lower cost than filament lamps. Popular auxiliary units are 150-watt spot and flood lamps built into



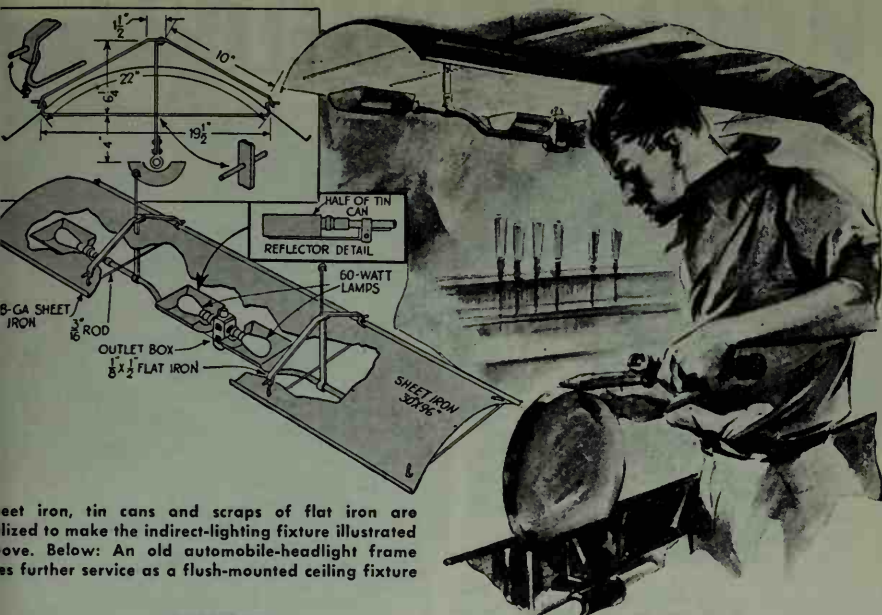
Popular Home photo

A 150-watt bulb and a 14-in. RLM dome put plenty of light on the machines at left. Above, lights are run under the shelves of a continuous workbench. Below, fluorescent lights beam underneath curved reflectors

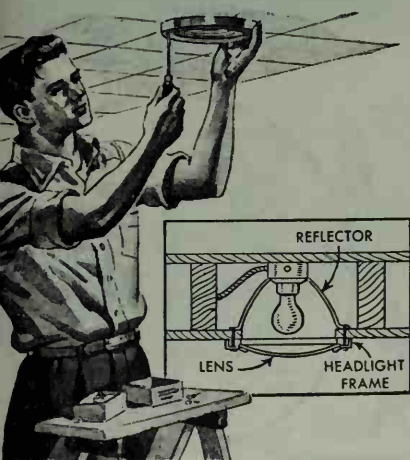


Atlas photo

a hard glass shell which supplies the reflector. One or two lamps of this kind, suitably placed, will provide intense illumination for critical machine work. A study of any large department-store catalog will acquaint you with many of the various lamps, reflectors and wiring devices avail



Sheet iron, tin cans and scraps of flat iron are utilized to make the indirect-lighting fixture illustrated above. Below: An old automobile-headlight frame serves further service as a flush-mounted ceiling fixture



le which are suitable for homeshop wiring and lighting.

An indirect-lighting fixture may be installed to give a diffused, shadowless light that is ideal for bench work. A sheet-iron reflector has the side edges turned up and stiffened with flat iron, and is held to a curved shape by iron-rod braces. The reflector is supported by two hangers as shown in the upper detail of the diagram above, the lower ends of the hangers having eyes bent on them to hold the conduit. This is connected at the center to a 2 x 1/2 in. outlet box, sockets being fastened to each side of the box. Other sockets are fas-

tened in a similar way to pipe caps on the outer ends of the conduit. Small shields are made by soldering halves of can covers to sheets of tin 7 in. square. These are fastened under the lights. To get a soft, evenly diffused light, the reflector and the shields should be given several coats of white paint.

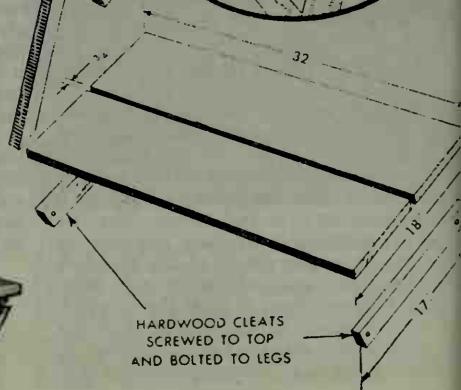
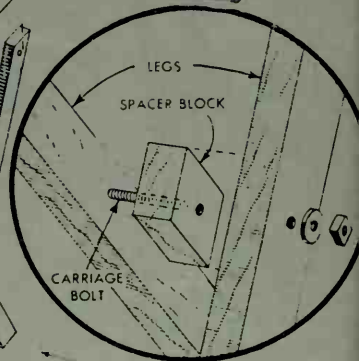
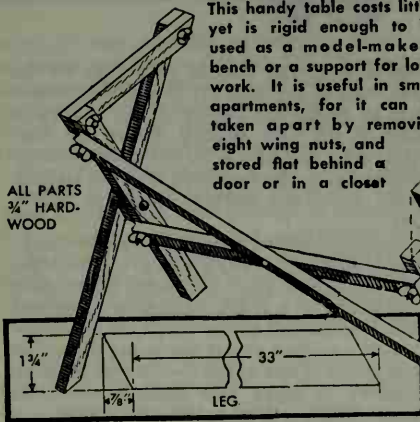
If your basement shop has a finished ceiling of wallboard or plywood, practical light units made from auto-headlight frames can be installed in a flush mounting as shown in the illustration at the left. Cut an opening in the ceiling about the same diameter as the front of the reflector. It will then be necessary to make two shallow saw cuts opposite each other so that the reflector can be pushed through the opening, the saw cuts permitting passage of the rim. As shown in the section drawing, the back of the reflector is cut out so that it will fit over a standard porcelain socket. The installation is given a neat finish by screwing the lens and frame in place. When the lamp burns out, it is easy enough to unscrew the frame and change bulbs. A light of this kind gives a concentrated spotlight effect and is most useful over the lathe or bench saw. The lamp is controlled by a wall switch.

WORK TABLE



This handy table costs little, yet is rigid enough to be used as a model-maker's bench or a support for long work. It is useful in small apartments, for it can be taken apart by removing eight wing nuts, and stored flat behind a door or in a closet

ALL PARTS
 $\frac{3}{4}$ " HARD-
WOOD



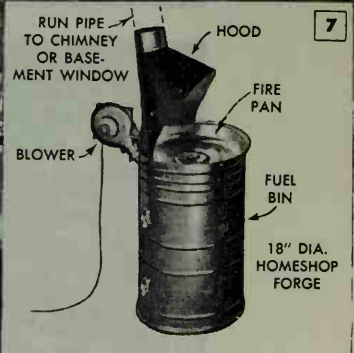
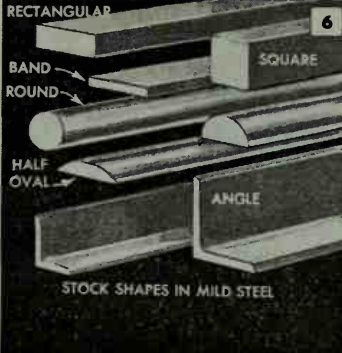
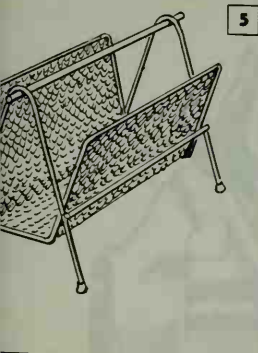
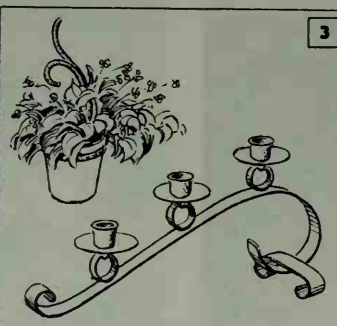
WROUGHT IRON

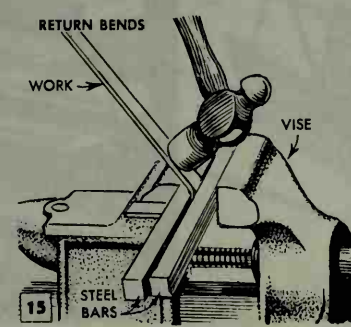
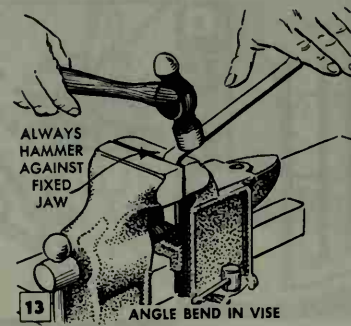
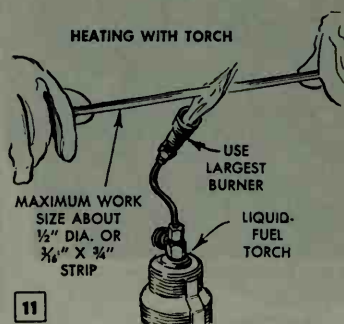
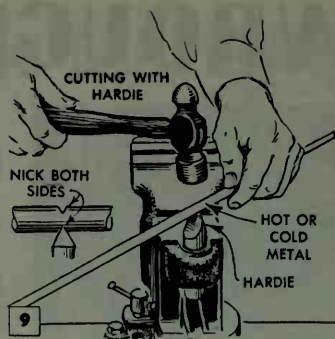


Photo courtesy Champion Blower and Forge Co.

FIRE IS THE SECRET of working ornamental wrought iron—a red-hot piece of iron can be bent easily to almost any shape. While the traditional heat source for iron-working is the open forge, excellent results can be achieved with an ordinary liquid-fuel hand torch. A torch, a hammer, a drill and some rivets are all the basic equipment needed. Figs. 2, 3, 4, and 5 show a few examples of the type of work that can be done either with the torch or a small forge.

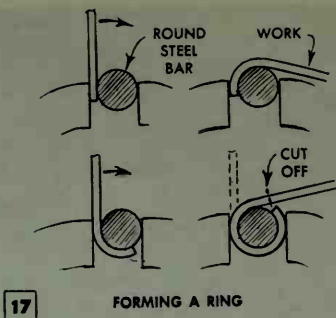
The metal: Old-fashioned wrought or puddled iron is no longer manufactured to any great extent because mild steel is nearly identical to it and much less expensive to make. The main feature of wrought iron or mild steel is that it contains only a trace of silicon and carbon. Such a material is tough, malleable, bends easily and welds beautifully. Unlike carbon steel, it does not harden when heated red hot and plunged into water. Some of the many stock shapes available in mild steel are shown in Fig. 6. The rectangular shape with rounded edges, usually called band iron or strap iron, can be purchased at many hardware and farm stores, while complete iron stocks for craft work are available from







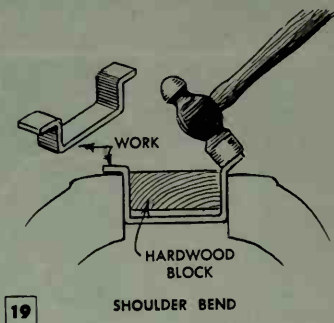
OFFSET ANGLE BEND



FORMING A RING



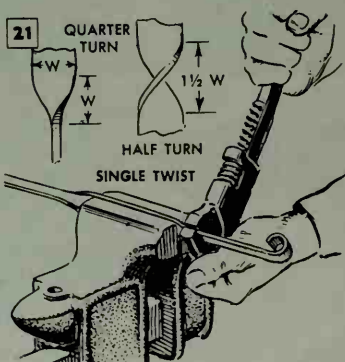
MAKING AN EYE

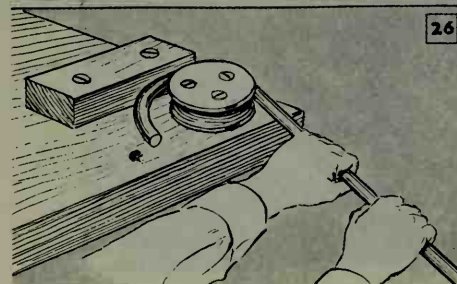
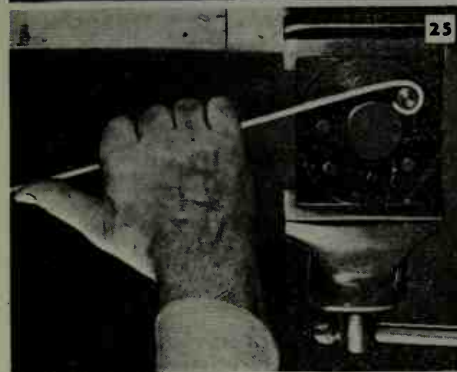
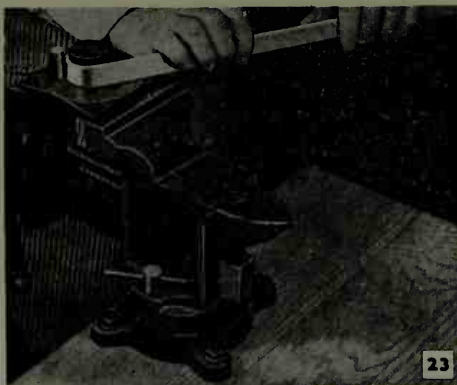


SHOULDER BEND



FORMING ON ROUND ANVIL





craft and metal-supply houses. The material usually is available in 10-ft. lengths for craft use.

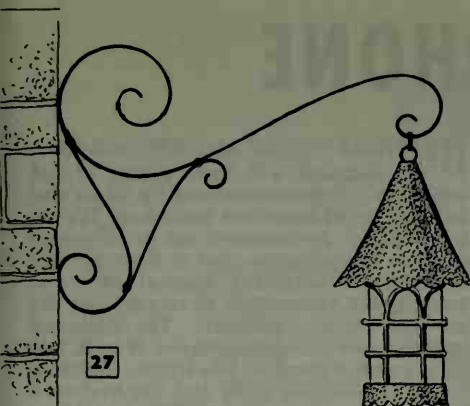
Heating equipment: Many projects in wrought iron can be worked cold. However, band iron over $\frac{1}{8}$ in. thick and rounds over $\frac{1}{4}$ in. in dia. become increasingly more difficult to bend. An inexpensive liquid-fuel torch is the least expensive and simplest solution. This type of torch will put a red heat on band iron up to about $\frac{3}{16}$ by $\frac{3}{4}$ in. and rounds to a $\frac{3}{8}$ -in. diameter. The localized nature of the heat, Fig. 11, makes the torch ideal for angular bending. As in Fig. 12, rod stock can be bent with hand pressure alone after torch heating.

One of the hottest heat sources is the twin-carbon arc torch, Fig. 29. An obvious disadvantage of the arc torch is that you have to wear a helmet and gloves for protection against the ultraviolet and infrared rays. A small arc torch, working on 110 volts, will heat rounds up to about $\frac{3}{4}$ in. in dia. for angular bending. Like all torches, however, it is generally unsatisfactory for heating a long length of rod.

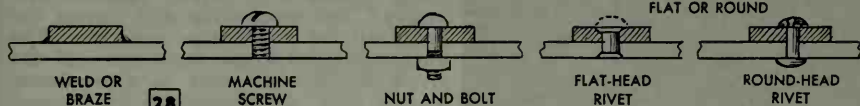
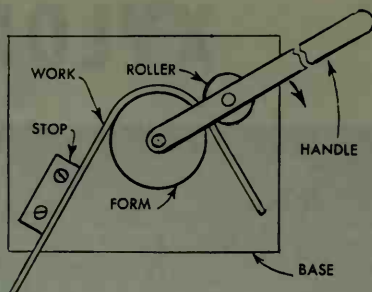
Most fascinating and satisfying of the heat sources is the time-honored forge, Fig. 1. This is the most flexible, most economical heat source for regular work. And, if you burn smithing charcoal, the fire will be clean and smokeless—practical for use in the basement workshop. A draft connection should be made to a chimney or to a basement window, in the latter case using a low-speed exhaust blower. A typical home-shop forge is shown in Fig. 7. The fire should be deep enough to bury the work yet protect it from direct air from the blower, Fig. 8. The forge will put a red heat on 2-in. dia. bar stock in about 5 minutes. With the forge fire, a large area or a long length of work can be heated uniformly, this being especially important for such jobs as making a long twist in a square bar, Fig. 22. On the other hand, if you want a sharp, angular bend, it is a simple matter to cool the work as desired with water from an oil can.

Basic operations: The basic operations in working with wrought iron are cutting and bending. Cutting is done with a hacksaw or with a chisel or hardie, Fig. 9. A 3-in. bench shear, Fig. 10, is ideal for cutting light stock up to $\frac{1}{8}$ by $\frac{3}{4}$ in.

Most of the basic bends are shown in Figs. 12 to 22. One of the most useful bending devices is a bar or a block of metal having one or more holes bored through it. This is used in the same way as the hex bar pictured in Fig. 14. An eye is formed by first making a ring, Fig. 17, and then bending the standing metal with the use of a vise, Fig. 18. Gradual bends of all kinds can



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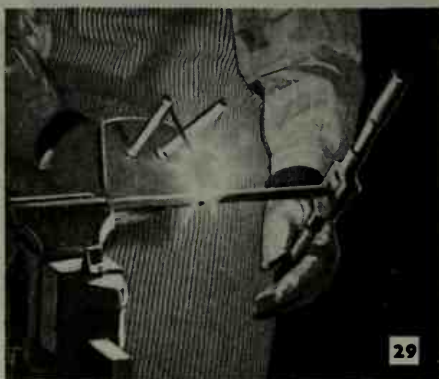
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be hammered hot or cold on any type of round anvil or bar, Fig. 20. Single twists with a quarter or half turn are made with a wrench, Fig. 21. In the details, W equals the width of the stock.

Scroll bends: Gradual curves or scrolls predominate all period designs in wrought iron. These curves are made on a bending jig. The jig consists of a purchased or home-made setup of two metal pins around which the work is bent, Figs. 23 to 25. Eye bends can be made directly around the smaller pin, Fig. 25, while large bends are worked gradually with a series of bends, Fig. 24. Large work also can be bent over wooden forms, Fig. 26, a method which is used widely for bending tubing. When a number of pieces are to be bent to the same curve, the handle-and-roller setup, Fig. 27, saves time and assures perfect work.

Fastenings: Ironwork is assembled by welding or brazing or with machine screws, bolts or rivets, as in Fig. 28. Riveting is the most popular home-shop method, and most riveting jobs can be done with the simplest of equipment, as in Fig. 30. Soft-soldering also is practical, although adhesion and strength are inferior to similar work on other metals.

Finishing: The most popular finish for all ironwork is flat or satin black paint. A protective or rust-inhibiting undercoat should be applied as a primer on all ironwork used outdoors. This is not essential for ironwork to be used indoors, but it is desirable to secure better adhesion of the finish paint. Antique iron usually is fire-blackened and then topcoated with paste wax to obtain a soft sheen. ★ ★ ★

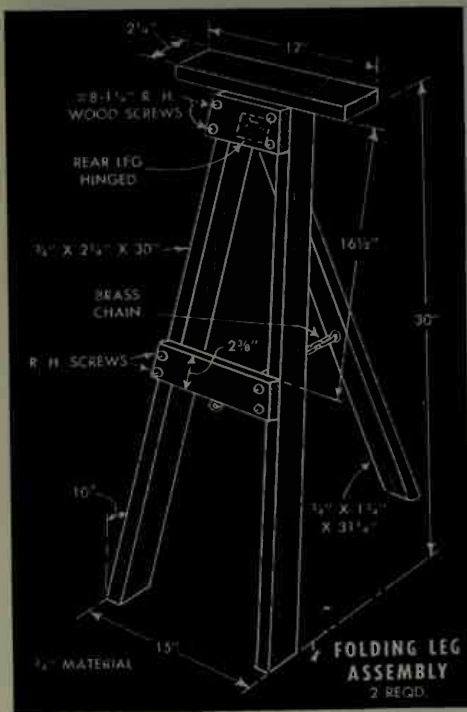


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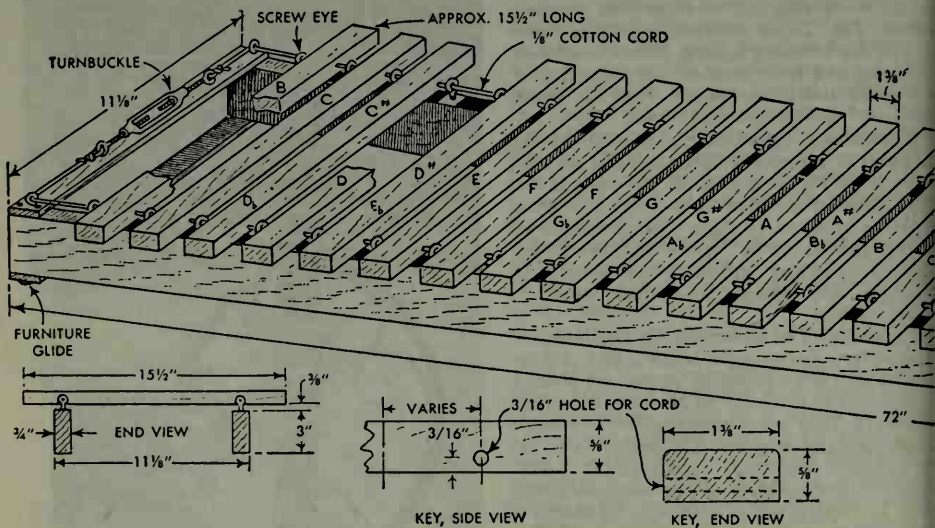
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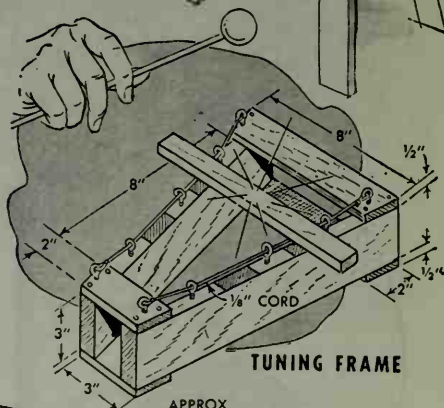
XYLOPHONE



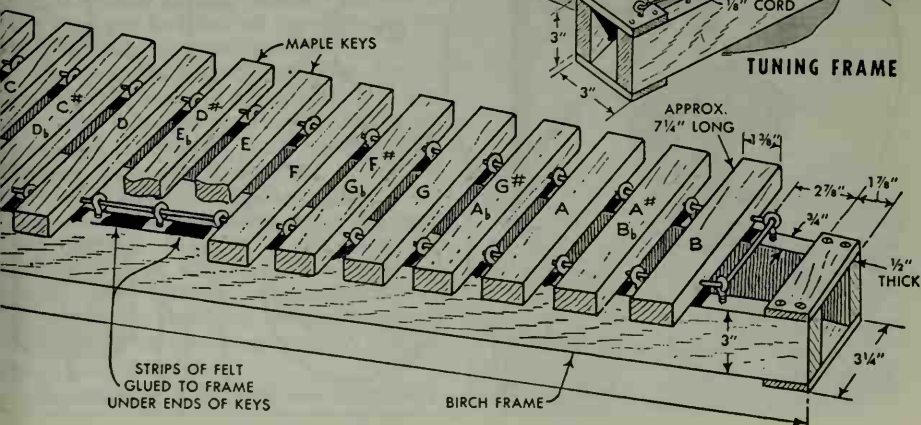
BUDDING YOUNG ARTISTS with musical leanings will have plenty of fun with this xylophone—especially when dad builds it in his basement workshop. It's not intended for professional use or advanced musical reproduction, but it does provide a means of acquiring manual skill and training for young ears in recognizing the notes of the musical scale. The keyboard includes two complete octaves, B to B, and all keys are located on one frame. Building the collapsible leg units and the keyboard frame requires only simple "sawhorse carpentry," but assembling and tuning the keys call for more time and care. The keys are ripped to the exact sectional size given, but are cut only to approximate lengths from the shortest to the longest. Use selected birch which is dry, straight-grained and sound. Each key must be tuned separately with a pitch pipe, and to do this make the tuning frame detailed on the opposite page.

Then make two hammers, or mallets, by drilling 1/4-in. holes in 1-in.-dia. wooden balls. Fit 12-in. lengths of 1/4-in. dowel as handles. Locate and drill transverse holes through all the keys as in the side view below. Place each key on the tuner as in the detail and rap it lightly with the mallet. Trim the end of the key about 1/2 in. and test again. Continue in this manner until the tone is true with the pitch pipe. Keep



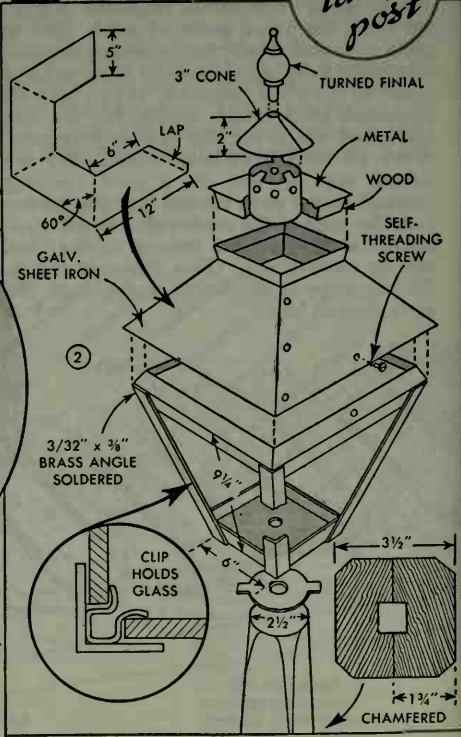
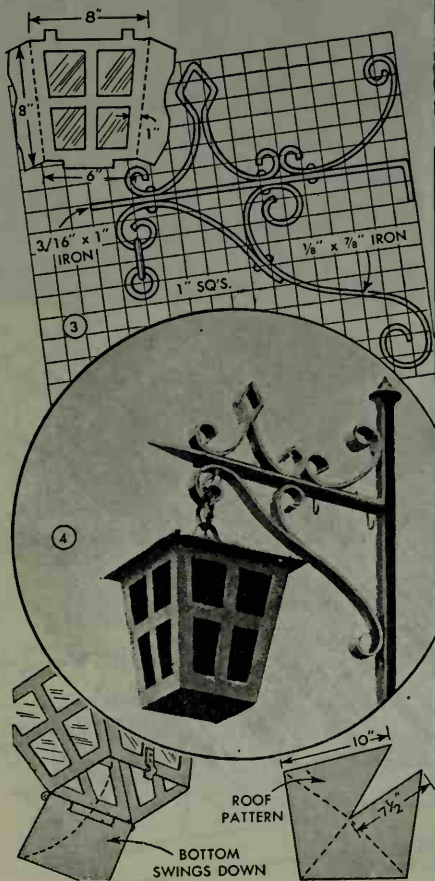


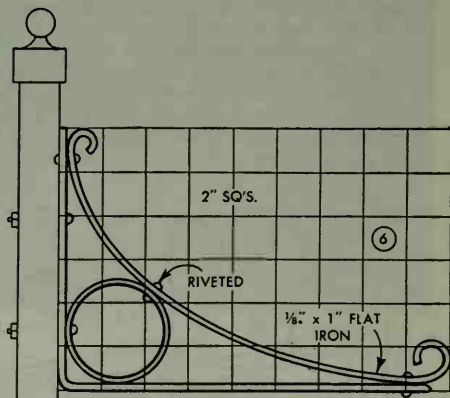
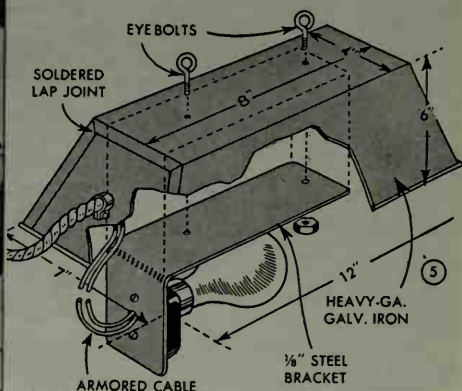
the keys in order as they are tuned. There will be some variation in response in keys cut from the same piece of stock, and in some instances it may be necessary to make substitute keys which may be trimmed and tuned to the pitch required. If you take off too much stock when tuning, lay the key aside and use it for the next higher note. When all keys have been tuned, they are strung one by one on a cord running through screw eyes turned into the frame. Join the ends of the cord with a small turn-buckle so that proper tension of the cord can be maintained. Glue strips of felt to the top edge of the frame underneath the ends of each key. ★ ★ ★



YARDLIGHT . . .
. . . at your gate

ANYONE with a period type home will appreciate one of these reproductions of old-style lamps. Mounted on a post at your entrance gate, the one in Figs. 1 and 2 is an electrified replica of an old gas street lamp, and can be made of brass or galvanized sheet iron. Brass angle stock is recommended for the frames around the glass, which should be especially sturdy. The top can be cut from a single sheet. Note that the wood post is made up of two pieces, which are first channelled for an electric armored





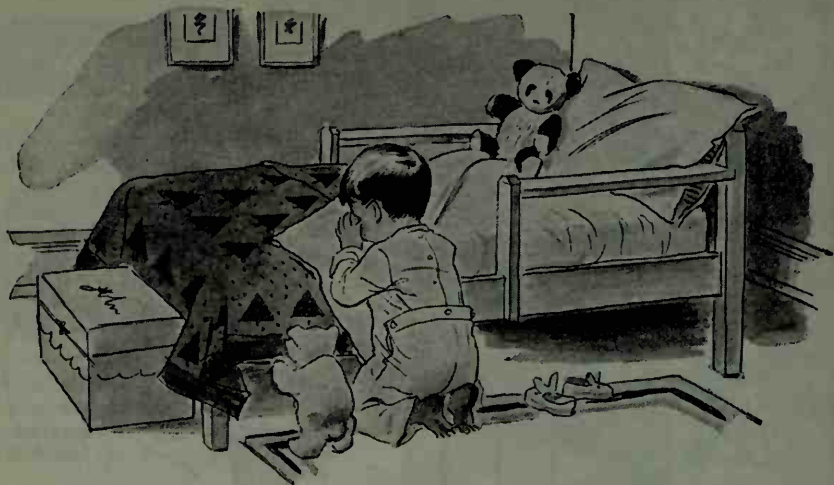
cable, and then fastened together. The lamp can be mounted on the post by using a disk of heavy sheet metal having tabs on opposite sides. Then the disk is soldered to the lamp bottom and the tabs are bent down over the sides of the post and screwed to it. It may be necessary to have four equally-spaced tabs on the disk in localities subjected to high winds. The top of the lamp can be lifted off for replacing the bulb by removing two screws.

The graceful lamp pictured in Figs. 3 and 4 can be made of galvanized sheet iron soldered together and supported by an iron-pipe standard with wrought-iron bracket. The latter may be riveted or welded. The top of the lamp is made in one piece, as is the frame supporting the glass. The latter is attractive in soft green tint, and is secured with galvanized tabs soldered inside the frame. The bottom swings downward for replacing bulbs. The standard should be set in concrete to a depth of at least 18 inches.

If your lawn is terraced and steps lead-

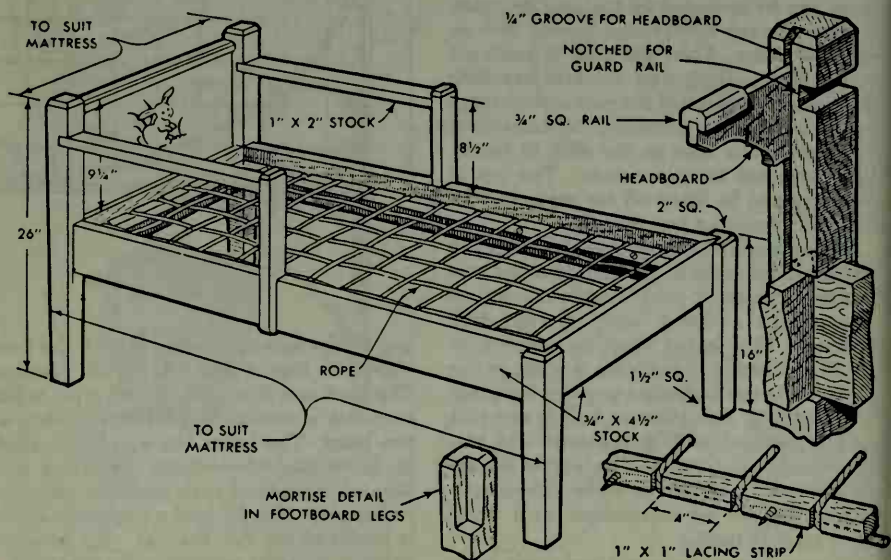
ing off the sidewalk are required, the lamp shown in Figs. 5 and 6 is highly pleasing. The post is a 2-in. galvanized pipe, which supports a wrought-iron bracket carrying the lamp. The latter has a reflector made of galvanized sheet iron. Inside, a steel bracket is secured with eyebolts, also used to hang the fixture, and a porcelain socket is fastened to the bracket. An armored cable is brought up inside the standard.

YOUNGSTER'S BED



Inexpensive and easy to build, this Hollywood-type youth bed is just the thing for baby when he begins to outgrow his crib. Except for a headboard panel of $\frac{1}{4}$ -in. plywood, the bed is made entirely of solid stock. Over-all dimensions of the bed and the length of the guard rails are not given in the detail as these are determined by the size of the mattress, the guard rails being approximately half the length of the bed. Note that the bed rails are fastened perma-

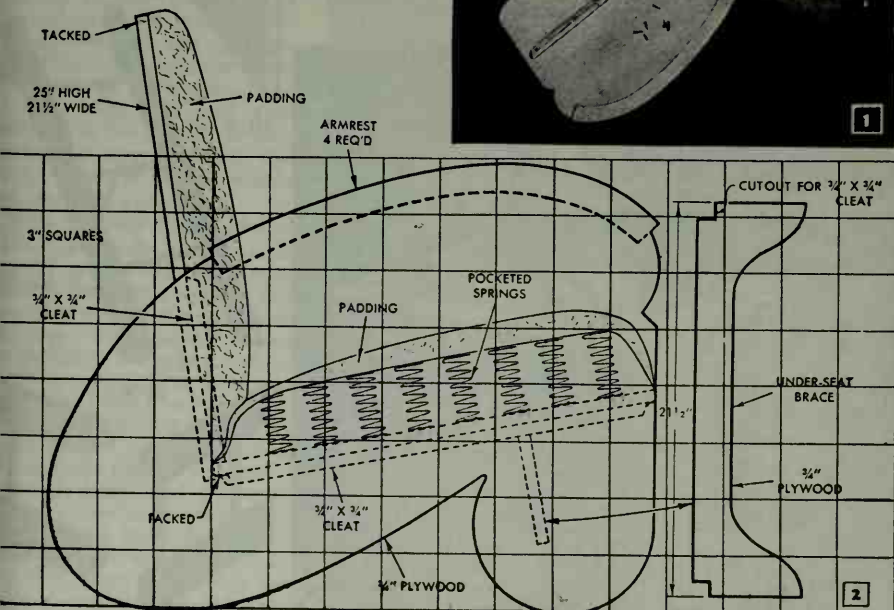
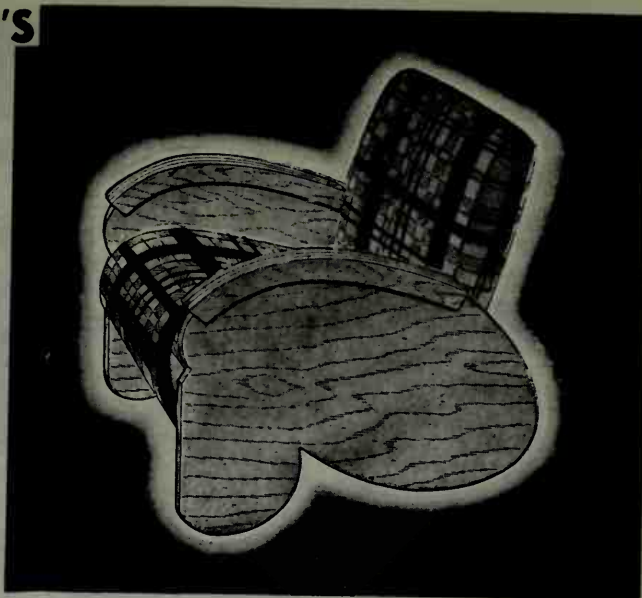
nently to the headboard and the footboard by mitering the ends and gluing and nailing them into mortises in the tapered legs. After the bed is assembled, a rope spring (clothesline will do) is laced through notched strips of 1×1 -in. stock screwed to the sides of the bed rails as well as to the headboard and the footboard. After all nails are set and puttied over, the bed is enameled, using either a two-tone effect or a color to harmonize with the bedroom.



YOUNGSTER'S CHAIR

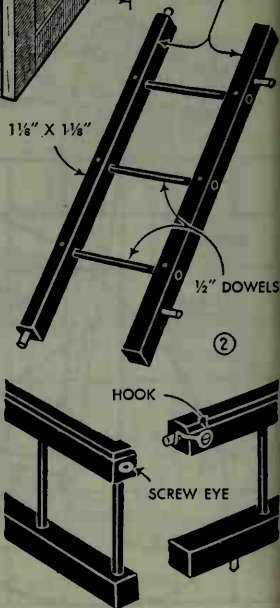
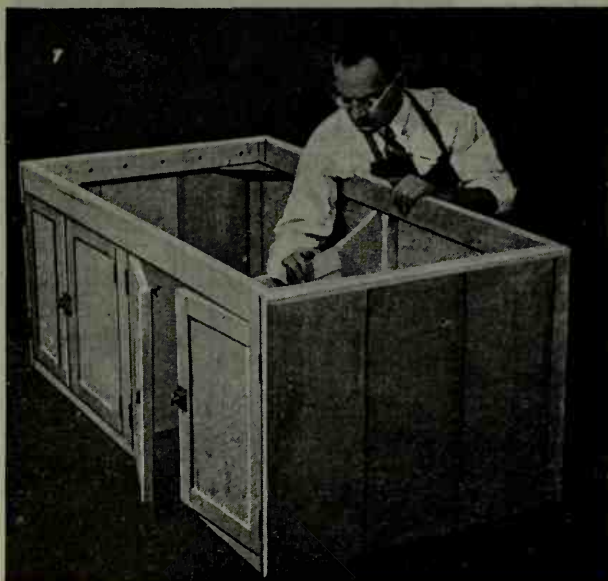
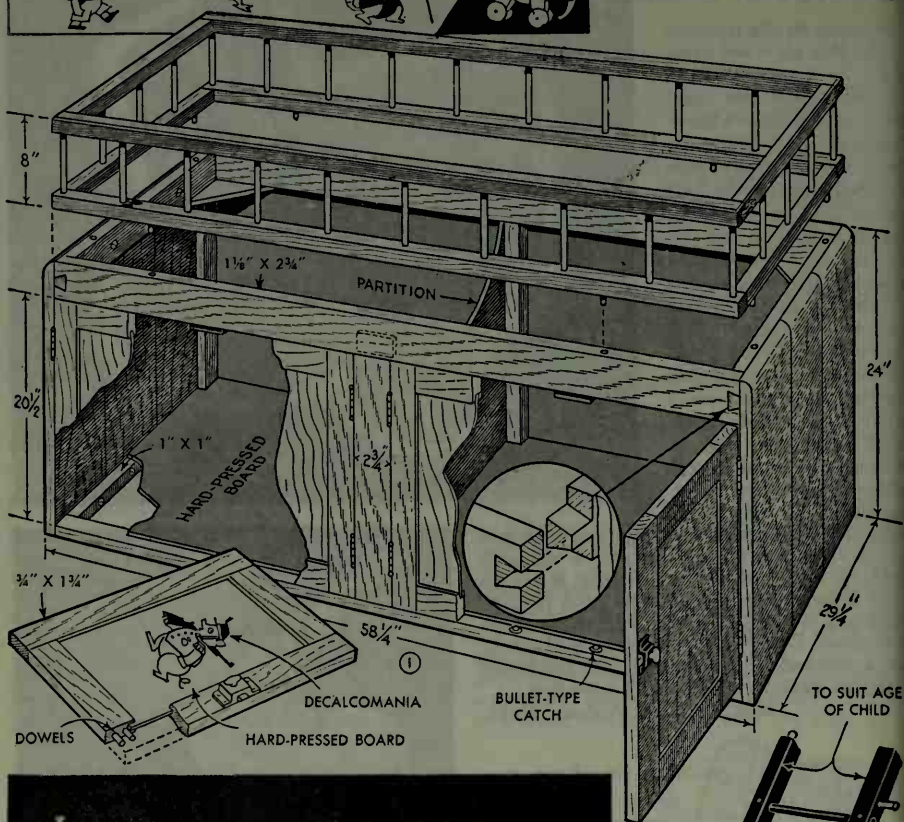
Strictly in the modern mode, this plywood arm-chair is easy to make and adds just the right informal touch to a basement rumpus room or front porch. First, saw out the sides and the four pieces for the armrests, Fig. 2, and then cut the bottom and back, and fasten in place by means of cleats, Fig. 1. The armrests are glued and screwed in place. In addition to the bottom cleats, an under-seat brace is required, right-hand detail of Fig. 2. When the sides, back and bottom are assembled, the chair is ready to be upholstered. Pocketed springs are used and are covered with padding and a suitable cloth. If foam rubber is available, it can be used instead of padding with good results. Stain the wood and finish with three coats of shellac. Or by way of variety, you might use a colored enamel finish that contrasts with the pattern of the cloth covering.

Benj. Nielsen, Aurora, Nebr.





YOUNGSTER'S



CHEST-BED

IN SMALL homes and apartments where it is impossible to furnish a room for the child, this combination bed and chest will be of real value, as it serves as a comfortable bed at night and provides storage space for extra blankets, toys and other household items. In daytime, removing the railings and covering the chest with an appropriate drapery converts it into a useful couch. If made higher than shown in Fig. 1, the railings can be removed and set up separately to form a child's play pen. When used in this way, however, a floor for the pen must be assembled and drilled for pegs to keep the railings in place.

Before assembling the frame, have the springs at hand so they can be measured, as the exact size of the chest depends upon these dimensions. Corners of the frame are dovetailed and glued, with triangular blocks glued and screwed to the underside of the top members at each corner to support the springs. Note that the ends of the chest are built up of tongue-and-groove stock, glued and screwed to the frame. To improve the appearance, the outer edges of these boards are rounded at the top.

Note that the chest is fitted with a partition which is curved at the top to prevent the springs hitting it when they are pressed down by weight of a person sitting or lying on them. Railings are assembled quickly by clamping the upper and lower members together and drilling them both at the same time. The holes should be just large enough to provide a sliding fit for the dowels, these being held in place by glue and small finishing nails driven in from the sides. To prevent shifting of the railings, tapered pegs are fitted in the lower members to correspond with holes drilled at the top of the chest frame as shown in Fig. 2. End railings are also fitted with pegs which slip into holes drilled in the side railings. Hooks and screw eyes lock the railings together.



Doors are hung with hinges having removable pins for convenience in detaching them, in case the edges need planing to make them fit accurately. A stop block at the top and bullet-type catches in the bottom rail hold the doors shut. Or, you can fit them with elbow catches and cabinet latches, if desired. Although the bed is somewhat higher than cribs in general, this gives the advantages of adding to the storage space, Fig. 3, and facilitating making the bed with a minimum of stooping for the housewife. Low railings are also a convenience where the bed is made without removing them. Decalcomania transfers are applied in the center of each door.

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